Railway Mechanical Engineer

December 1944

Published monthly by Simmons-Boardman Publishing Corporation, 1309 Noble Street, Philadelphia, Pa. Entered as second-class matter, April 3, 1933, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription price, $3.00 for one year, U. S. and Canada. Single copies, 35 cents. Vol. 118, No. 12.

RAILWAY MECHANICAL ENGINEER

(Name Registered, U. S. Patent Office)
With which is incorporated the RAILWAY ELECTRICAL ENGINEER.

Founded in 1832 as the American Rail-Road Journal

DECEMBER, 1944

Volume 118 — *No. 12*

Published on the second day of each month by
Simmons-Boardman Publishing Corporation

SAMUEL O. DUNN, *Chairman of Board, Chicago;* HENRY LEE, *President, New York,* ROY V. WRIGHT, *Vice-Pres. and Sec., New York,* FREDERICK H. THOMPSON, *Vice-Pres., Cleveland;* FREDERICK C. KOCH, *Vice-Pres., New York;* ROBERT E. THAYER, *Vice-Pres., New York;* H. A. MORRISON, *Vice-Pres., Chicago;* J. G. LYNE, *Vice-Pres., New York;* H. E. McCANDLESS, *Vice-Pres., New York;* JOHN T. DEMOTT, *Treas. and Asst. Sec., New York.*

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.), and is indexed by the Industrial Arts Index and also by the Engineering Index Service. PRINTED IN U. S. A.

1309 Noble street, Philadelphia, Pa. Editorial and Executive Offices: 30 Church street, New York 7, and 105 West Adams street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D. C.; 1038 Henry bldg., Seattle 1, Wash.; 300 Montgomery street, Room 805-806, San Francisco 4, Calif.; 560 W. Sixth street, Los Angeles 14, Calif.

Subscriptions, payable in advance and postage free, United States, U. S. possessions and Canada; 1 year, $3; 2 years, $5. Foreign countries: 1 year, $4; 2 years, $7. Single copies, 35 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York 7.

Locomotive:

Quality of Locomotive Fuel 553
Boiler Feedwater Treatment 555
What Causes Plugged Nettings? 562
Fire—Air—Water 564

General:

Southern Diesel Repair Shops 549
A.S.M. Session on Metals for the Railroads 558

Editorials:

Penny Wise, Pound Foolish 567
Isn't This Market Worth Special Effort? 567
Decoration of Passenger Cars 568
Corrosion of Steel in Concrete 569
Spaciousness—A Factor in Competition 569
New Books 569

Backshop and Enginehouse:

The Maintenance of Locomotive Air Compressors 570
Flame Hardening Piston-Head Ring Grooves 573
Testing Mechanical Lubricators 574
Locomotive Boiler Questions and Answers 574
Welding Repair to Engine-Truck Casting 575
Boiler Backhead and Cab Work on Southern 575

Car Foremen and Inspectors:

Maintaining Air Brake Equipment 576
Questions and Answers on Welding Practices 579
Carrier for AB Reservoirs 579
Southern Paint Track Facilities 579

Electrical Section:

Progressive Motor Maintenance (Part II) 581
Electrical Section Reports 586
Improved Lubrication for Traction Motor Bearings 589

New Devices:

Three-Way Foot Valve 590
Joint Sealing and Anti-Seize Compound 590
Shankless Twist Drill 590
Diesel Air Filter 590

News 591

Index to Advertisers ..... (Adv. Section) 130

Firebox glaring! . . . Side rods flashing! . . . Flanges screaming! . . . The Red Ball Freight must go through.

Only the best bearings and bronze castings can stand up under such brutal punishment. Keep your equipment "on the beam" by specifying

N·B·M
CAR JOURNAL BEARINGS AND ENGINE CASTINGS

NBM

NATIONAL BEARING METALS CORPORATION

ST. LOUIS · NEW YORK

AMERICAN Brake Shoe COMPANY

Handling Road and Switching Power at

Southern Diesel Repair Shops

Present facilities serve as proving grounds in shop design — Re-refining of oil important feature—Repair schedule is on mileage basis

MAINTENANCE and repair operations on Diesel-electric road and switching locomotives on the western lines of the Southern at Ludlow, Ky., and Chattanooga, Tenn., have provided this road with much knowledge concerning the shop facilities which they will require as their ownership of this type of equipment increases. These two shops which have been in operation for a number of years are alike in many of their essential features, and have served adequately in handling the present volume of work.

While newer shops will be larger and are expected to be more convenient for handling Diesel servicing and maintenance, they will include most of the features which have worked out successfully at Ludlow and Chattanooga.

FORM 1009

Locomotive Unit { Number ..... Initials .....

SOUTHERN RAILWAY SYSTEM

Locomotives Other Than Steam

DAILY LOCOMOTIVE INSPECTION REPORT

INSTRUCTIONS—Each Locomotive must be inspected after each trip or day's work and report made on this form whether needing repairs or not. Proper explanation must be made hereon for failure to repair any defects reported, and the form approved by foreman before the locomotive is returned to service.

Inspected at ....., Time ..... M. Date ..... 19....

Repairs needed:	Repairs made by

CONDITION OF:

Main Engine Pistons ..... Traction Motors .....
" " Bearings ..... Main Generator .....
" " Oil Pumps ..... " " Exciter .....
Fuel System ..... Control Circuit .....
Exhaust Piping ..... Sanders .....
Water Cooling System ..... Do Bearings Run Cool? .....
Water pump ..... Window Wipers .....
Cooling Fans ..... Train Control .....
Air Compressor ..... " " Cut out at M. P. .....
Brakes ..... " " In at M. P. .....
Brake Valve .....
Main Reservoir Pressure ..... lbs.; Leakage ..... lbs.
Brake Pipe Pressure ..... lbs.; Leakage ..... lbs.
Piston Travel ..... Inches

(Signature) .....

(Occupation) .....

The above work has been performed, except as noted, and the report is approved

.....
Foreman

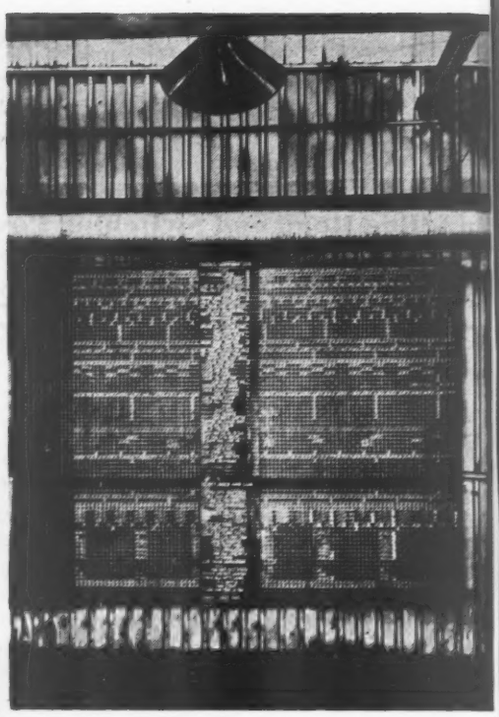
Fig. 1—Locomotive engineer's report form

Each has two full-length tracks built to handle a three-unit locomotive and a shorter track long enough for either a single unit or a switching engine. Working pits are provided between the tracks which have the necessary connections and piping for crankcase drainage. The pits are illuminated with lighting fixtures in the side walls.

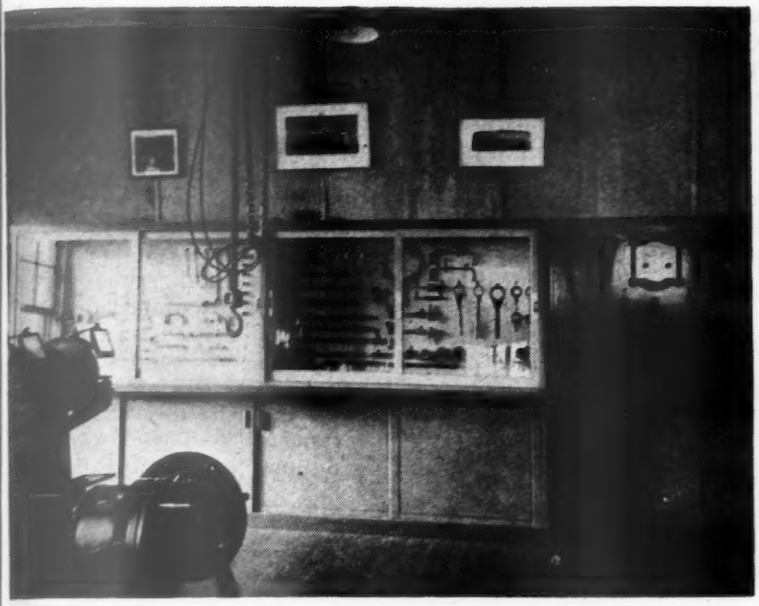
Both shops have full-length permanent working platforms at the cab floor level and the machine shop and toolroom in each is on the same level as the platforms. The shop at Ludlow has a further advantage in that the storehouse stock of spare Diesel parts is located in the shop building and on the working floor level.

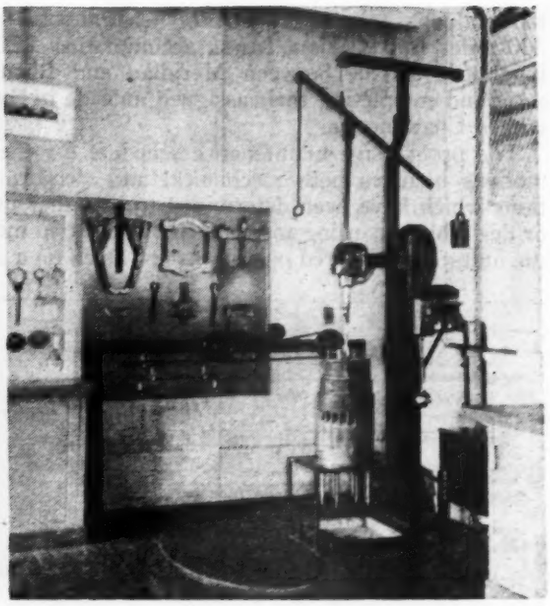
At the present time only switching locomotives are inspected, maintained and repaired at Ludlow and the shop facilities are required only at the time of monthly or other periodic inspections inasmuch as daily inspection and servicing is done in the railroad's yards at Cincinnati, Ohio, where these switching locomotives are used. The shop formerly was used also in the maintenance of road power which has been shifted temporarily to other districts on the system. Electro-Motive 1,000-hp. switchers work from Ludlow and American Locomotive Company 1,000-hp. switchers from Chattanooga.

The shop at Chattanooga is a terminal point for the inspection, servicing and repair of both road and shifting power. Sixteen Electro-Motive freight Diesel units operating as six locomotives—four 4,050-hp. and two 2,700-hp. locomotives—are maintained on the progressive system at this point. Depending upon the service assignment these locomotives receive attention at either the end of 1,500 miles or 1,800 miles of service. This mileage variation is accounted for because of the difference in demands made upon the locomotives in their operating territories. Those which receive 1,500 mile attention are released from the Chattanooga shop to run to Danville, Ky., a distance of approximately 225 miles. They then make four round trips between Danville, and Oakdale, Tenn., each round trip averaging 275 miles, and from Danville return to Chattanooga to complete their 1,500 miles and undergo the necessary adjustments and repairs provided for in the running maintenance schedule. Locomotives in the 1,800 mile class operate in the less



Above: Maintenance schedule board—Top left: Full-length pits and working platforms make all parts of the locomotives accessible—Left: Filter cleaners and drying ovens are on the working level — Bottom left: Oil, water, steam and air lines are beneath the platforms—Below: Pits have lighting fixtures and are equipped with drop tables





Above: Tools are kept in cabinets fitted with sliding doors—Top right: Cylinder liner honing machine. Against the wall is a belt matcher—Right: A transfer table is used when removing trucks—Bottom right: Storehouse stocks of Diesel parts are kept in the shop building—Below: Cylinder heads are reconditioned in a special holding jig which permits positioning

mountainous territory south of Chattanooga, running 300 miles to Meridian, Miss., accumulating 1,200 miles in shuttle service between Meridian and Birmingham, Ala., and completing their assigned mileage in the return trip to Chattanooga.

The progressive maintenance schedule for these locomotives includes both mechanical and electrical operations which have been determined to be either necessary or desirable according to the accumulated trip mileage of the units; the required operations are listed on a schedule

Form 1070

SOUTHERN RAILWAY SYSTEM

FIREMAN'S OPERATION REPORT, DIESEL-ELECTRIC LOCOMOTIVES

Locomotive Number_____ Date_____ 194 Engineer_____

Train Number_____ Division_____ Number Cars_____

All Readings to Be Taken With Engines at Full Load, Every 30 Minutes

			"A" UNIT						"B" UNIT					
TIME OF READING														
Cooling System	Water Temperatures	1st. Eng.												
		2nd. Eng.												
	Height of Eng. Cooling Water in Glass	1st. Eng.												
		2nd. Eng.												
DIESEL ENGINES	LUBE OIL PRESSURE 1st. ENG.	Main Brg.												
		Pstn.Cool												
		R.P.M.												
	LUBE OIL PRESSURE 2nd ENG.	Main Brg.												
		Pstn.Cool												
		R.P.M.												
	FUEL OIL PRESSURE 1st. ENG.	Filter In												
		Filter Out												
	FUEL OIL PRESSURE 2nd ENG.	Filter In												
		Filter Out												
	Load Indicator Notch	1st. Eng.												
	Throttle Setting?	2nd. Eng.												
Elect.	Auxiliary Generator	1st. Eng.												
	Charging Amperes	2nd. Eng.												
Boiler	Boiler Steam Pressure													
	Steam Hose on Training													
	Boiler Separator Used?													
	Boiler Soot Blowers Used?													
MISCELLANEOUS	Control Air Pressure	1st. Eng.												
		2nd. Eng.												
	Fuel Purolators Turned (3)													
	Main Reservoir Pressure													
	Condition of Steam Boiler During Trip		A.						B.					
	Condition of Blower Fans		Bolts			Piping			Any Leaks?					
	Water Pump Pressure During Trip	Highest Reading	A1.		2.				B1.		2.			
		Lowest Reading	A1.		2.				B1.		2.			
	Tool Cabinet Locked?		Any Tools Missing?						If So, State Below					
	Number on Tool Lock Beginning Trip					Number on Tool Lock End Trip								
	Amount Water in Tanks Beginning Trip		A.			Reserve			B.					
	Amount Fuel in Tanks Beginning Trip		A.						B.					
	Height Lube Oil in Tanks		A1.		2.				B1.		2.			

REMARKS: (Note Any Irregular Conditions)

Above conditions are correct as noted

Signed_____

Fireman.

Fig. 2—Fireman's report

board prominently displayed in the shop. Before locomotives are returned to service a standard work sheet is prepared and filed listing the work done and the mechanic responsible for its performance.

Maintenance operations other than those regularly provided for are performed as their necessity is shown on the daily locomotive inspection report which each engineer submits when delivering the locomotive at terminal points. A copy of this form is shown in Fig. 1. Not only is the locomotive engineer required to make an operating report but the fireman also prepares a complete performance record of the locomotive for the time while he is riding it. The report which he submits is shown as Fig. 2.

Shop Tools and Equipment

Both shops are outfitted with all tooling required to recondition cylinder heads, valves and liners and to test fuel injector nozzles, gauges and electrical equipment. At Ludlow there is a 15-ton Whiting drop table which is used when changing out wheels and traction-motor assemblies while the Chattanooga shop is equipped with an 82½-ton Whiting transfer table with which entire trucks can be removed from underneath a locomotive for repairs and wheel or traction motor changes.

A feature of special interest at Chattanooga is the arrangement whereby, because of the close proximity of the stores department oil refining facilities to the Diesel repair shops, it is possible to remove oil from a crankcase and return it after re-refining to another Diesel engine crankcase without any drum handling of the oil. Oil as drained from the crankcases is forced by a scavenger pump into dirty oil storage tanks in the stores department oil houses. The Refinol process for making this oil suitable for reuse is employed. The re-refined oil is held in storage tanks and pumped back to the Diesel repair shop for delivery at the lubricating oil outlets along the service tracks when it has been determined that required specifications for crankcase oil have been met in the re-refining process. Samples of each batch of oil are sent to the engineer of tests for checking.

Oil changes are made as directed by the engineer of tests in accordance with a standard sampling procedure set up by the railroad. Fig. 3 shows the form used in sub-

Form TD-5
2-1-44

INFORMATION ACCOMPANYING SAMPLE OF DIESEL ENGINE LUBRICATING OIL TO BE TESTED IN LABORATORY (ROAD AND SWITCHING DIESEL LOCOMOTIVE)

1. Company material check number under which sample is sent to Test Dept. _____
2. Locomotive No. _____ Unit (A,B,C or D) _____ Engine (1 or 2) _____
3. Brand and SAE No. of oil _____
4. Date sample was taken _____
5. Date previous oil change _____
6. Mileage (Road engines) or Hours (Switch engines) since previous oil change _____
7. Make-up oil added since previous oil change _____ gallons
8. Was oil changed at time this sample was taken? _____
9. Reason for changing oil (if answer to No. 8 is "Yes") _____

INSTRUCTIONS - Samples of oil are to be sent to R. H. Beverley, Engineer of Tests, Southern Railway System, Alexandria, Va., according to the following schedule:

Freight Locomotives - Each 5,000 miles of service

Passenger Locomotives - Each 10,000 miles of service

Switching Locomotives - Each 700 hours of service

Also, whenever oil is changed for any reason, a sample of the oil removed from engine is to be submitted. In this case please indicate reason for change in answer to Item 9.

Samples should be 1 quart and should be submitted in clean screw top can. (Supply of cans available on request to Engineer of Tests)

This form to be filled out completely for each sample and sent to Engineer of Tests. Report on test results will be sent to all concerned.

In order to be useful the samples must be sent in promptly after they are taken.

Submitted by _____

Address _____

Fig. 3—Crankcase oil samples are submitted with this form to the engineer of tests

mitting oil samples. The oil samples are taken from the engine sump while the engine is still hot. Maximum mileages between oil changes is 20,000 miles on road power. Switchers have oil changed every 700 hours.

Out of Service Time

The Electro-Motive 1,000-hp. Diesel switchers at Ludlow and the Alco 1,000-hp. switching locomotives at Chattanooga require an average daily servicing time of twenty minutes, a semi-monthly inspection period of about four hours, a monthly inspection time of six hours, and they are in the shops for approximately sixteen hours at the time of their annual inspections. A heavy overhaul on the switching locomotives on a two-year basis is expected to average between 48 and 60 hours. The road units operating from Chattanooga are in the shop for about ten hours between either their 1,500 or 1,800 mileage periods and require about 30 hours for annual inspections. Monthly inspections can be made in the usual between-trip attention time.

British Swelling Index Used to Determine

Quality of Locomotive Fuel*

A. C. Geertz

By Allan O. Geertz†

Suitability of fuels easily checked by simple tests in laboratory—Crop coals are readily identified and variations in quality detected

Correctly defined, crop coal is weathered, oxidized, soft structure coal. It is usually stained throughout. A lump can be crushed in one hand, and has innumerable tiny fissures throughout the structure due to weather action. Now because this kind of coal is often found in the first or opening cut of a strip operation, many people have gotten to calling first cut coal "crop", and what is worse will insist that second or third cut coal is not "crop", regardless of quality, merely because it is not first cut. This has been the cause of many arguments between inspectors and strip operators and is really a misunderstanding of terms. It has been found under 40 to 50 ft. of cover, and in fourth or fifth cuts.

The usual proximate chemical analysis in some cases does not indicate any wide deviation from normal coal in the same field, and it becomes a question as to how to determine crop coal simply and quickly.

Normal bituminous coals swell to a greater or lesser degree as they are burned at atmospheric pressure. Back in 1939, while studying another problem entirely, my attention was called to the British Swelling Index as a measure of free swelling of various coals. This test is simple, standardized, and quick, and it was made an addition to our regular coal analysis in the laboratory. It was not long before the relationship between this index and the quality of the coal became very evident. In the first four cases of steam failure which were clearly traceable to poor coal, as shown by several successive trains failing out of one terminal, the analysis of coal removed from the tenders showed a swelling index of 0 or 1. Since we had learned that coal from that particular field should have a swelling of 7, this low swelling on the coal that caused failure appeared to be more than a coincidence. It should be added here that a coal which does not agglomerate at all, that is, will show no signs of caking, is arbitrarily listed as zero swelling index, although the British Scale does not show any figure below 1.

Accordingly samples were taken at various pits from

* From a paper prepared for the 1944 year book of the Railway Fuel and Traveling Engineers' Association. † Fuel engineer, Pennsylvania.

EXTRACT FROM B.S. 804

British Standards Institution.

CRUCIBLE SWELLING TEST FOR COAL

Standard Profiles and Corresponding Swelling Numbers

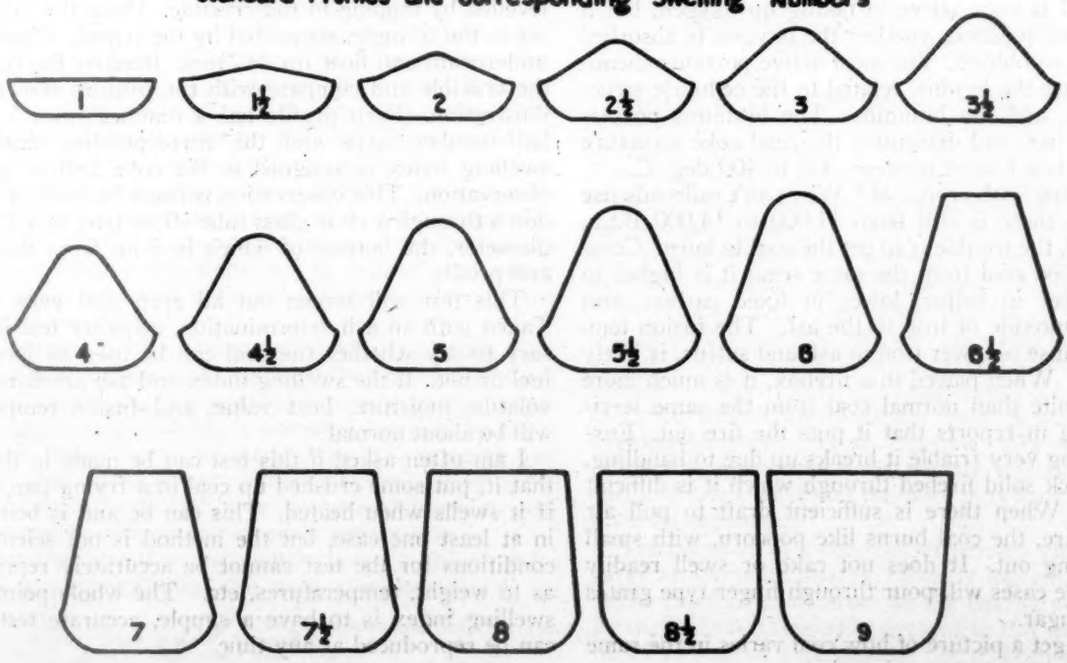


Table I—Analyses of Six Samples from a Strip Pit

Sample No.	5	2	1	6	3	4
Location	Center of first cut	20 ft. back of shovel highwall, first cut	100 ft. back of shovel—outcrop of first cut	Highwall, second cut	40 ft. back of shovel center of second cut	10 ft. back of shovel highwall, second cut
Swelling index	0	1	1½	2	8	9
Moisture	6.91	2.70	1.56	1.30	.80	.14
Volatile	25.93	25.13	25.34	25.24	24.02	24.19
Fixed carbon	59.04	63.41	64.72	67.11	66.23	67.50
Ash	8.12	8.76	8.38	6.35	8.95	8.17
Sulfur	.56	.39	.36	.63	1.67	2.20
B.t.u.	11862	12979	13367	13918	13995	14415
Fe_2O_3 in ash	14.19	22.11	20.79	13.42	26.18	32.73
Softening point	2490	2220	2220	2630	2470	2380
Fusion temperature	2720	2390	2460	2800	2610	2510
Difference between softening point and fusion temp., deg.	230	170	240	170	140	130
Grindability	121	...	...	108	105	105

Interpretation:
(1) Arranged in order of increasing swelling index.
(2) Moisture is consistently less.
(3) Volatile: practically no change.
(4) Fixed carbon: increases consistently.
(5) Ash: practically same.
(6) Sulfur: varies but higher in good coal.
(7) B.t.u.: consistently higher.
(8) Fe_2O_3: varies, but higher in good coal.
(9) Softening and fusion point: not predictable.
(9) Softening and fusion point: not predictable.
(10) Difference in temp. between softening point and fusion temp.: gradually goes down; less clinkering.

which we had received coal which gave us trouble. In each case we found that the good hard structure coal had a higher swelling index than more friable coal nearer the crop line in the same pit. From this point it was a short step to finding out what the swelling index should be for the various districts in which we buy coal. Here we ran into another curious fact; that is, that the normal swelling index of good coal gets steadily lower, as the fields progress westward. In the Pennsylvania low volatile field, a B.s.i. of 9 is not uncommon, in the Clearfield District 8, in the Pittsburgh District 7, in the West Virginia Panhandle 6, in Ohio 4 and 5, and in Indiana and Illinois 2½ to 5. I am not qualified to speak about coals west of the Mississippi, but would like to suggest that the normal British swelling indices for western coals should be studied by those of you who use those coals. Indications are that they may follow a different pattern of behavior.

The chemistry of crop coal is not thoroughly understood as yet. Oxidation is undoubtedly a very complex process. Coal is very active in taking up oxygen, but it is still an open question whether the oxygen is absorbed or chemically combined. The most active portions chemically in coal are the lignins, related to the cellulose structure of wood, and the bitumins. The bitumins possess plastic properties, and determine the final coke structure or swelling when heated between 300 to 400 deg. C.

What's wrong with crop coal? Why can't railroads use it? Although there is still from 11,000 to 14,000 B.t.u. in each pound, the trouble is to get the coal to burn. Compared with good coal from the same seam it is higher in moisture, lower in sulfur, lower in fixed carbon, and lower in sesquioxide of iron in the ash. The fusion temperature, because of lower iron in ash and sulfur, is likely to be higher. When placed in a firebox, it is much more difficult to ignite than normal coal from the same territory, resulting in reports that it puts the fire out. Furthermore, being very friable it breaks up due to handling, forming a thick solid firebed through which it is difficult to draw air. When there is sufficient draft to pull air through the fire, the coal burns like popcorn, with small sparks shooting out. It does not cake or swell readily and in extreme cases will pour through finger type grates like red hot sugar.

In order to get a picture of how coal varies in the same strip pit, six samples were taken at different locations in one pit in Central Pennsylvania. No sample was more than 500 ft. from the furthest: that is to say, all the changes in the analyses occurred within 500 ft. Table I will give an idea of how the coal varies.

Now observe the relationship of the new characteristic—the swelling index. Note in Table I that it increases consistently with the quality of the coal, whether judged on the basis of heat value, fixed carbon, or moisture. That is, coal from a given field, whose characteristics are known, can be judged by the swelling index, which is quickly obtained as well as by the better known indices, which require considerable time to complete.

Referring again to the fact that the normal swelling indices vary from district to district, Table II lists the swelling indices normal to each of the fields which we have so far studied. It is very important, in using this index to judge coals, that this point be never lost sight of, that good coal from each field has a characteristic swelling index, and that the comparative values of coal must be judged by deviation from the normal figure for that field, and not by the absolute figure.

The standard method for making this test can be found in British Standard Institution Bulletin No. 804, issued July, 1938, at a price of two shillings. The equipment required consists of a crucible of fused silica with lid, a triangle to hold the crucible, a tripod to support the triangle over the burner and a Bunsen burner capable of maintaining a temperature of 820 deg. C. or 1,508 deg. F. One gram of coal, air-dried and passing 60 mesh, is levelled by tapping in the crucible. Place the lid on, and set in the triangle, supported by the tripod. Place burner underneath and heat for 2½ min. Remove the coke from the crucible and compare with the profiles shown in the illustration. Each profile has a number from 1 to 9 in half-number steps and the corresponding number or swelling index is assigned to the coke button by visual observation. This observation is made by looking straight down through a clear glass tube 10 in. long and 1½ in. in diameter, the bottom of which is 3 in. from the sample and profile.

Table II—British Swelling Indices To Be Expected From Eastern Coals Bought for Locomotive Fuel

Swelling index	General outline of territory
8 -9	Cresson, Clearfield, South Fork, Nantyglo.
7½-9	Conemaugh Division, Bolivar west to Aspinwall.
7½-8½	Greensburg, Connellsville, Fairchance, Latrobe, Jeannette.
7 -8	Kittanning, Sligo, Dubois, Driftwood.
6½-7½	Panhandle Territory in Penna. & West Va.
6 -8	W. Virginia (N. & W. & C. & O.).
6 -7	Steubenville, Wierton, St. Clairsville, Ohio.
5 -7½	Eastern Kentucky.
4½-5	Salineville, Ohio.
4 -6½	Cadiz, Ohio.
3½-5	Western Kentucky.
3½-5	Zanesville, Cambridge, Caldwell, Ohio.
3½-5½	Illinois.
2½-5	Indiana.

This test will screen out all crop coal very quickly. Taken with an ash determination, no other test is necessary to say whether the coal can be used as locomotive fuel or not. If the swelling index and ash are normal, the volatile, moisture, heat value, and fusion temperatures will be about normal.

I am often asked if this test can be made in the field; that it, put some crushed up coal in a frying pan and see if it swells when heated. This can be and is being done in at least one case, but the method is not scientific, as conditions for the test cannot be accurately reproduced, as to weight, temperatures, etc. The whole point of the swelling index is to have a simple, accurate test which can be reproduced at any time.

Colloidal Organic

Boiler Feedwater Treatment*

By Jean de Frank†

INTERNAL locomotive water treatment, i.e. treatment in the boiler itself, appears to be a practical railroad necessity due to the limitations of the pre-treating methods now in effect. All pre-treating programs have the same basic limitations. They require considerable initial investments for equipment, are difficult to adapt to all points of water supply and demand constant and close analytical supervision by a trained staff. When you consider further that supplemental after-treatment is also usually required, it is logical that attention has long been focused largely on the internal methods.

Internal treatment of feedwater can be divided into three principal groups: (a) the chemical (inorganic) method; (b) the inorganic-organic method; (c) the all-colloidal organic method.

The Chemical (Inorganic) Method

This group includes the use of all substances which react chemically with the scale-forming salts present in water. Common examples are soda ash and tri-sodium phosphate. The basis of the inorganic chemical method is reaction or, more plainly, substitution. A treating chemical is introduced into the water to react with the scale-forming matter such as calcium or magnesium salts present in the water. The purpose is to produce new salt combinations which would be non-scale-forming or otherwise less objectionable than the original ones.

In such processes, it is expected that the resultant precipitates will not adhere to the metal and will be removed by periodic blowdown. Also, the use of an excess of the alkaline reagents is expected to afford protection against corrosion. It is specifically emphasized "is expected" because railroad usage has highlighted reactions which were not expected or which actually introduced tendencies toward foaming, corrosion and other evils.

The one basic fact about any inorganic chemical reagent is that its specific chemical composition limits its usefulness. A chemical of one set composition cannot and should not react in equal fashion with waters of varying contents. As an instance, it cannot be expected that the same chemical would treat highly acidic and highly alkaline waters with equal success. This applies in particular to railroad systems, which have to use waters of many origins and various compositions. Benefits from the use of inorganic chemicals cannot be denied, but such benefits are more noticeable in stationary boilers where feedwaters of fairly constant composition can be utilized and where it is easier to organize frequent, regular analyses of the raw and boiler waters.

The limitations of inorganic chemical treatments have led many investigators ever since the beginnings of water treatment to perform thousands of experiments with physical-acting materials which, it was hoped, would be effective on all impurities in all waters. In both research and practical application, some of these physical-acting materials, or "organic colloids", were eventually found to possess the sought-after water-treating properties.

Rather than dwell on individual phases in the progress of such experimentation, the author wishes merely to point out that as with all innovations—the application of organic colloidal conditioning had to advance on a very thorny road and could only very slowly, step by step, gain recognition.

Colloids

A colloid is a substance, the particles of which when properly dispersed, fall within the range of size just above molecules. They are micronic in size and have properties entirely their own. As an example, colloids clearly exhibit Brownian movement and the particles of a colloidal dispersion do not deposit or settle out, their mutual attraction for each other being greater than the force of gravity.

This distinction as to particle size of colloids is basic in all understanding of the subject and a simplified chart shows how the colloidal dispersion is intermediate in size between the true molecular solution and the suspension.

To give a practical idea of the enormous surface area made available by reduction of a substance's particles to colloidal size, it has been calculated that one gram of graphite, decimated to colloidal dimensions has a total surface area of 1,173 sq. ft. This illustration in terms of surface area is noteworthy because it is surface area which motivates many of the colloidal properties. The inability of colloids to pass through fine filters such as parchment paper is a result of their surface area.

A colloidal dispersion of a given colloid is known as the "sol" of that colloid. When the colloid is coagulated by some external force, it is known as a "gel". An example of gel formation is the solidification of the white of an egg upon boiling. Starch, tannin, glue, and gelatin are common examples of colloids.

Organic Colloidal Properties in Water Treatment

The two all-important properties of organic colloids in connection with water treatment are adsorption and coagulation. Adsorption is simply the ability of a body's surface to retain such substances as may come in contact with it. This ability to adsorb is in direct proportion to the size and structure of the surface area. Since particles in a colloidal state have tremendous surface areas, they have correspondingly very powerful adsorptive qualities.

By coagulation is meant the process of flocculation of matter which is in the colloidal state and its precipitation as a gel. This occurs by application of some outside influence or force. Many sols require only a nominal change to cause their transformation from a stable sol to an agglomerated gel. As an example, this may be accomplished by application of a minute electrical charge. A curdling takes place and the flocs thus formed are precipitated as sediment.

The particles of a colloidal dispersion characteristically carry an electrical charge. This is extremely useful in a boiler since neutralization of the charge may be effected by the scale forming salts present in the water. Coagulation and mutual precipitation occur, both the colloid and

* A paper on Topic 2, Treating Boiler Feedwater, for the 1944 year book of the Master Boiler Makers' Association.

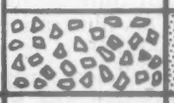
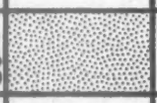
† American K. A. T. Corporation, New York.

the scale forming salts being precipitated as a gel together. It is important to note that they precipitate together because the gel places a film over the salt particles, preventing their interlocking with each other as crystals of scale. The soft, pliable nature of the precipitate is maintained since it contains such a large proportion of water in it. For this reason it does not bake on the boiler metal during operation and can be easily blown out.

Since adsorption and coagulation are purely physical occurrences, organic colloids, properly selected, are effective with all waters regardless of their chemical composition. In passing, it might be mentioned also that gases present in the water are also adsorbed by the colloid and form part of the ultimate gel. The coating or sheathing mentioned previously is not confined to the impurities, but takes place also on all interior metal surfaces contacted by the water. Some colloids deposit an easily observable thin, heat-conductive film on the metal which is extremely desirable as a shield against corrosion.

Organic Colloids and Foaming

There is no question that the prevention of foaming and consequent reduction of priming is particularly a realm for organic colloidal treatments. The use of castor oil in this connection is well known and other organic treatments have been at least equally effective. The basis of such effectiveness is that the suspended matter, whether as impurities originally present in the water or as solids resulting from crystallization, is removed with the gel when coagulation and precipitation take place. The mechanism of foaming is itself subject to some dispute, but apparently foaming does not occur except in the presence of suspended matter at the water's surface. The so-called foam-blanket is broken up by the organic colloid, the surface tension lowered and free liberation of the steam bubbles occurs. A very important point is that organic colloid conditioning does not in itself introduce the quantities of treating solids that are required when inorganic chemicals are used. F. J. Matthews, in his book "Boiler Feed Water Treatments", says: "Normal chemical softening will leave over a pound of sodium sulphate in the water for every pound of calcium sulphate removed. This adds to the density of the water and under evaporation the density may soon reach the point where priming obtains. Owing to the lesser quantity of colloid used, the density is not so high initially; this is particularly true where no chemical pretreatment is adopted and the addition of colloid comprises the entire boiler protection." Of course, organic colloids will not eliminate such priming as may occur through mechanical causes such as uneven firing, inadequate steaming space, carrying too high a water level or sudden full-throttle load demand.

	SUSPENSIONS	COLLOIDS	SOLUTIONS (MOLECULAR)
			
VISIBILITY OF PARTICLES	By eye or through microscope	Through ultra-microscope	Undetectable even through ultra-microscope
DIAMETER OF PARTICLES	Greater than 100 millimicrons	From 1 millimicron to 100 millimicrons	Below 1 millimicron
EXAMPLES	Sand in Water Milk of Magnesia	Starch Glue	Sugar in water Salt water

Colloidal dispersion falls between suspensions of matter and true solutions in water

Joint Use of Inorganic Chemical and Organic Colloid Treatments

If both treatments, the inorganic chemical as well as the organic colloidal, are fed simultaneously, we are utilizing two completely opposing principles one of which may be described as disintegrative and the other as integrative. When we do this, we are in no position to predict in which direction results will be achieved. The organic colloids will affect the analytical control tests required with the use of inorganic chemicals and indeed will inevitably act on the chemicals themselves before they have done their work. This entire process is disruptive and at best wasteful.

On one sizable railroad system in Europe, it has been the practice to use for feedwater treatment of locomotive boilers a so-called phosphate mixture. This phosphate mixture represents a combination of phosphates, sodium hydroxide and oak extracts. The table illustrates the dosages of that compound used per ton of water evaporated at 100 per cent make-up.

A Phosphate Mixture Used on a European Railroad

Total hardness of the feedwater, grains per gal.	Phosphates, grams	Sodium hydroxide, grams	Oak extract, grams
3 — 8	10	15	5
9 — 15	10	20	5
16 — 25	15	25	5
26 — 40	15	30	5
41 — and over	20	35	5

Note that the organic colloid (oak extract) was fed in the same amount regardless of the water hardness, while the dosages of phosphates and caustic soda were increased with increased hardness. The presumption in this case was that the inorganic chemicals would first react with the scale-forming salts, precipitating them out of solution and that the organic colloid would then appear on the scene to conclude the job that the chemicals had started. Actually, both forms of treatment work in the boiler simultaneously and use of them jointly denies each of them full effectiveness.

Apparently, the mixture did have some effect against formation of hard scale; whether it also rendered protection against corrosion and pitting could not be determined. Foaming was not at all abated, but increased so that the blowdown exceeded the most liberal norms, reach 20 to 25 per cent of the total water to be evaporated. Superheater units were in a terrible condition and were the constant object of uneasiness and fear of necessitating taking locomotives out of service.

The joint use of inorganic chemicals and organic colloids arose as a mere yielding to the increased recognition given organic colloids. Because this practice still gave partially satisfactory results, the development of all-colloidal organic water treatment was again retarded.

Use of inorganic chemicals and organic colloids not simultaneously but successively, has been found to be a very excellent form of treatment. It would be ideal were the completed action of the inorganic chemicals to take place prior to use of the organic colloids. In practice, many roads having pre-softening equipment are now using organic colloids as after-treatments with extremely good results on all counts—scale elimination, adequate treatment of residual hardness, prevention of corrosion and, of course, in reduction of foaming, with resultant decreased blow-down expense.

The fact that organic colloids have certain general properties does not mean that any organic colloid is suitable for use in a boiler. Many colloids are prematurely coagulated by the mere presence of heat, others decompose or lose their adsorptive or protective properties. It is essential that coagulation be due chiefly to neutralization of electrical charges as previously described. The writer in his early researches with organic colloids, in collaboration with Blacher and Clark, tested over 300 organic substances and charted them individually for their anti-scale, anti-corrosion and anti-foam properties. These included agar-agar, cambier, oak extract, the galls, quebracho, castor oil, a variety of starches, tannins, dextrins, etc., almost all such substances known.

This work proved beyond doubt that no one substance possessed all the desired properties and that a combination of various ones was required. The task was complicated by the fact that such separate substances had to be of a similar nature and able to withstand high pressures and temperatures without decomposition or premature coagulation taking place. After many years of experimentation along these lines, such a combination was developed and commercially produced as an emulsion. Since most of this final work was done in Riga, Latvia, the first practical application of the emulsion was in 1929 on the small Latvian naval fleet and on merchant ships. Several of these were equipped with Thornycroft boilers which, with their small-diameter bent tubes, afforded severe opportunities for test. Results over years being extremely satisfactory, the government, from 1934 on, used the all-colloidal organic emulsion in all government-operated locomotives. In subsequent years many other Scandinavian and Baltic railroads adopted this treatment, using it with great success. Successful trials were run by the Polish and Dutch governments, and from 1937 on this emulsion was applied on the French railroad, Chemin de Fer de l'Est. German occupation of all of these countries ended all such developments except in Sweden where the emulsion continues in use by railroads. Since 1938 it has been manufactured and marketed in the United States by an independent American corporation. Usage of this emulsion is currently proving of great value in keeping boilers free of scale and corrosion over extended operating periods and in elimination of foaming.

Locomotive Blow-Downs

When inorganic chemicals are used, locomotive boiler water concentration must be kept below certain established limits. Otherwise, uneasy steaming, foaming and priming are experienced. It is common American railroad practice to keep concentration limits within the range of 200 to 250 grains per gallon. Keeping concentrations arbitrarily within this range is an expensive procedure.

In an article by I. N. Moseley, general boiler maker, Norfolk & Western, in the 1942 Proceedings of the Master Boiler Makers' Association, figures are quoted which are very comparable to those of European railroads. In the 200 to 250 grains per gallon concentration range, in order to lessen boiler-water concentrations by one grain, it was necessary to blow from 43.30 gals. to 57.29 gals., or an average of 50 gals. of water.

In his book, "Water Treatment and Purification", W. J. Ryan examines a formula for blowdown, illustrating cases where completely softened water is used. He points out that all salts entering the boiler in the feedwater must eventually find their way out through the blowdown. Therefore, gallons of blowdown × dissolved salts per gallon of blowdown = gallons of feedwater × dissolved salts per gallon of feedwater, and consequently gallons of blowdown = gallons of feedwater × the ratio of dissolved salts per gallon of feedwater to dissolved salts per gallon of blowdown. For instance, if the feedwater contains 12 grains per gallon of dissolved solids and it is desired to limit the concentration of dissolved solids to 200 grains per gallon, the required blowdown will be 12 ÷ 200, or 6 per cent.

This specific relationship between concentrations desired and blowdown required is worth noting. In railroad practice blowdown with use of chemicals is usually high because certain relationships of alkalinities to dissolved solids, of suspended solids to dissolved solids, etc., are ordinarily the governing factors.

The complications and costs of blowdown when using chemicals were indicated in B. C. King's paper presented in the 1940 proceedings of the Master Boiler Makers' Association.

He described a condition where it was found necessary to carry alkalinities at 30 percent or more of the total dissolved solids in order to prevent scale and corrosion. When this was done severe foaming occurred at concentrations of 125 to 175 grains. Road blowdown of 12 percent to 15 percent was required and in one locality as high as 24 per cent. This impractical situation was solved by adding predominantly organic materials. This allowed locomotives which previously foamed at concentrations of 125 grains per gallon to be operated at 1,900 grains per gallon concentrations without trouble.

In Europe, when using the organic colloidal emulsion, locomotives were officially permitted to carry concentrations of 1.5 deg. Baume which equals 874 grains per gallon. In actual practice, this figure was habitually exceeded; in fact, it was found unimportant to pay any further attention to concentrations. It should be remembered that the entire purpose of maintaining certain limits of concentration rests in the desire to prevent undesirable effects, principally foaming. In the absence of such effects, there is no practical limit to concentrations and to limit them only costs money without any corresponding benefit. The savings made possible in this connection are very great.

An entirely separate saving in regard to blowdown results from the fact that blowdown with use of organic colloids is far more effective than when inorganic chemicals are used. This is because the adsorptive and coagulative actions of the organic colloids produce a very pronounced downward funneling movement of the impurities toward the blowdown outlets. Each gallon of effluent is viscous, thoroughly laden with impurities. For this reason only short blows are necessary. In contrast, treatment with inorganic chemicals ordinarily requires much longer blows to strip the impurities which are more generally distributed throughout the boiler.

Using organic colloids, European railroads found it entirely practical to open the blowdown valves for only three or four seconds except at the terminals where eight- or ten-second blows were used. This sufficed to remove the accumulated sediment without losing valuable heated water. A Class I railroad in this country, using ten-second blowdowns—still a shorter than customary blow—has experienced very substantial savings. Freight engines on a 324-mile round trip were blown each ten miles, each of two blowdown valves being opened twice for five seconds each. The same was done at terminals.

In water, this schedule figured to about 1,100 gals. per round trip. Before the use of an organic colloidal emulsion the blowdown was calculated as from 11,200 to 14,280 gals. per round trip, or from 9.4 percent to over 12 percent of the total of 119,000 gals. of water consumed.

(Continued on page 566)

A. S. M. Has Panel Session on

Metals for the Railroads

Study of metals a constant one for railroad engineers and designers — Laboratory, shop and service findings all important

ON October 18 at Cleveland, Ohio, during the annual meeting of the American Society for Metals, a session was held which was devoted to the subject, "Metals for Railroads." Dr. William M. Barr, chief chemist and metallurgical engineer, Union Pacific, served as chairman of the meeting, and A. G. Trumbull, chief mechanical engineer, Chesapeake & Ohio, acted as summarizer.

Six papers were presented. Extensive abstracts, four are printed here. The two speakers whose papers do not appear were R. E. Cramer, special research associate professor of engineering, University of Illinois, and W. M. Murray, president, Society for Experimental Stress Analysis, Massachusetts Institute of Technology. Mr. Cramer's paper discussed the prevention of rail failures. In it he traced the history of rail development and the work which has been done in combating conditions which led to transverse fissures and other rail failures. He accented the fact that the advent of controlled-cooled rail has apparently solved the fissure problem.

Mr. Murray was unable to illustrate his paper with many examples of railroad studies of structural stresses in design but emphasized the fact that other industries, notably the aircraft industry, have found such work to be of extreme value if not indispensable. In commenting upon this paper Mr. Trumbull remarked that, to his knowledge, the only existing railroad mechanical structure that had been analyzed for stresses as a unit was the present approved A. A. R. box car and that the stress analysis work in that instance probably could have been much more complete.

Railroad Axles

*By O. J. Horger**

Design formulas for railroad car axles were developed by Reuleaux in 1896 and the fundamental geometry and dimensions established about fifty years ago have generally prevailed until recently. During this time, however, various metallurgical improvements were made in axle forgings. As the years went by the railroads became conscious of the increased dynamic forces being imposed on axles as a result of changes in operating conditions, such as increased speeds.

The percentage of axle failures in road service was very small. Generally speaking there was a known remedy for correcting these failures except for those fatigue fractures which developed in the axle under the pressed-on wheel. This later type of fracture is discussed here.

The solution to this problem obviously required fatigue tests but the manner in which this investigation proceeded was novel. Too much credit cannot be given to the decision of the Association of American Railroads to make fatigue tests on full size car axles. The fatigue testing of full size axles was initiated in 1937 and is still being continued 7 days a week and 24 hours a day.

What are the tangible results of this research? The design of the passenger car axle has been changed with no modification of material or heat-treatment to obtain 60 to 80 per cent increase in fatigue resistance at the wheel fit with only an increase of about 4 per cent in weight. A heat-treated tubular axle has been tested by the A. A. R. This tubular axle is about 30 per cent lighter in weight than the solid axle. Its better ratio of fatigue strength to weight over the solid axle is due to high residual compressive stresses in the outer surface. This axle is only about 0.35 per cent carbon without any added alloys and its favorable fatigue strength to weight ratio is obtained by quenching from the outside only, preventing quenching water from entering the bore, followed by a low-temperature draw. If a tubular axle was quenched both outside and inside or given a temper at the customary commercial value of about 1.000 deg. F, then it would have inferior fatigue resistance.

Improvements in fatigue resistance similar to those mentioned above for car axles have also been determined for driving axles and crank pins. Again the shape of the member has been modified to reduce the stress concentration occurring inside and near the end of the press fit. As an example, a circumferential relief groove as much as $\frac{7}{16}$ in. deep is turned in driving axles adjacent to the inside hub face of the wheel. The function of the groove is to obtain a better flow of stress between the axle and wheel so as to result in less stress concentration near the end of the wheel fit. This groove is rolled with a roller shape and pressure which is sufficient to deform the surface layers of the groove plastically. This rolling increases the fatigue resistance of the metal at the bottom of the groove and counteracts the detrimental influence that the notch would have in inviting failure to occur near the base of the groove. A large number of driving axles of this type have been placed in service and none have ever failed in the groove.

When axles or members develop fatigue fractures it is common practice to make the entire part instead of improving the design in the region of fracture. This procedure leads to increased rigidity and under impact loading contributes to higher stresses than would be obtained with a more flexible axle. Increased train speeds are considered to result in larger impact forces on axles than occur at low speed. Under these conditions it is desirable that the axle be as flexible as possible without developing failure as well as of light weight so as to absorb this impact energy by means of maximum deflection and with minimum impact stress. Using this analysis it can be explained how most designs of wheel centers with great lateral stiffness would increase the impact stresses in an axle from flange thrust over that obtained with a more flexible type center. It would be kind to the axle if a wheel center design could be provided of adequate strength but greater lateral flexibility than we have on most of the wheel centers being used today.

* In charge railway engineering and research, Timken Roller Bearing Company, Canton, Ohio.

A number of railroads are rolling the wheel fit portion of driving axles. Rolling will about double the fatigue resistance of the axle against actually breaking off in the wheel fit. There is no other known means of doubling the factor of safety against road failures at so small a cost. A combination of rolling and the relief groove has enabled some railroads to obtain greatly increased axle mileage. The present limited practice of machining out the very shallow fatigue cracks that may develop in the axle wheel fit made in this manner and then rerolling is one which could be safely extended in its use.

We have all observed the patches of brown iron oxide found in particularly large amounts near the ends of the press fit. This is caused in service by minute sliding action of the end portion of the hub bore on the axle surface due to the alternate elongation and contraction of the axle fibers during the rotation of the axle. This minute and continuous rubbing of the wheel on the axle under bending stress results in one of the highest forms of stress concentration and weakening effect on the fatigue strength of steel that is known. Fatigue cracks start due to this rubbing corrosion at very low axle bending stresses but they generally will not propagate in depth at the same low stress value—a higher stress is usually required for propagation of the fatigue crack. The solution to the press-fitted problem divides itself into two parts.

The first part deals with the initiation of the fatigue crack. During the life of an axle there are a large number of stress reversals of sufficiently low magnitude to start a fatigue crack. It was found from fatigue tests of the old black collar design of car axle (as forged—not heat treated after forging) that any nominal calculated bending stress in the wheel fit exceeding 9,000 lb. per sq. in. would be likely to start a fatigue crack in the wheel fit. By a change in axle shape so as to mount the wheel on a raised seat in accordance with the design of the present A. A. R. passenger-car axle, this 9,000 lb. per sq. in. was increased to an allowable 12,000 lb. per sq. in., or an improvement of 33 per cent. If no practical change in shape of the wheel seat was made but surface residual compressive stresses were present in the axle, like the tubular axle, then this 9,000 lb. per sq. in. was increased by 50 per cent to 13,500 lb. per sq. in. It was also found that fatigue cracks would initiate in the wheel fit of the new design of normalized and tempered passenger-car axle when the bending stress exceeded 9,000 lb. per sq. in., or at a stress 3,000 lb. per sq. in. lower than for the same design of axle in the as-forged condition. All these stress values apply to car axles where the ratio of wheel-seat diameter to the length of the wheel hub approaches unity. With driving axles and crankpins, however, these stress values are less favorable, possibly due to this ratio being much greater than unity; here we find that fatigue cracks may initiate at stresses as low as about 5,000 lb. per sq. in., nominal bending stress, as compared with 9,000 lb. per sq. in. for the car axle. It is therefore apparent that even if a 50 per cent improvement in fatigue resistance could be obtained over the 5,000 lb. per sq. in. that the increased resistance would still be much below the regular stresses that could be expected in service operation. This problem of preventing fatigue cracks initiating in driving axles and crank pins is much more difficult of solution than for car axles.

The second part of the problem is concerned with the propagation of the fatigue crack which has initiated in the wheel fit as described above. In order actually to break off a car axle (as forged) in the wheel fit it generally requires a stress increment about 2,000 to 7,000 lb. per sq. in. above that required for initiation of the fatigue crack; the actual stress depends on several factors of which the carbon content is one. For normalized and tempered axles this increment is less than 1,000 lb. per sq. in. The normalized and tempered condition gives a less favorable structure than the as-forged from the standpoint of car-axle fatigue resistance at the wheel fit. While this statement is contrary to generally accepted opinion, such findings have resulted from laboratory testing of many full-size axles; it remains to be substantiated or found in error through the results of road tests which are not now available. On crank pins and possibly driving axles, normalized and tempered, the nominal stress must exceed 11,000 lb. per sq. in. to cause the incipient fatigue cracks to propagate to complete fracture.

By rolling the wheel seats of such members or heat-treating in a manner to leave high surface residual compressive stresses a nominal bending stress of as much as 22,000 lb. per sq. in. is required to propagate initial cracks to a depth of about ¼ in. in 300,000 equivalent miles. A stress greater than 22,000 lb. per sq. in. would be required to propagate to complete fracture. Certainly this characteristic of greatly retarding crack propagation is of practical advantage from three angles, it greatly increases the factor of safety of the axle breaking off in service; mileage may be increased before axle examination; and, after 300,000 miles service the fatigue cracks, if present, are shallow enough that they may be generally machined out and the axle returned to service with safety for another mileage period.

In summarization, it may be said that axles and crank pins may be improved by proper shape but it is almost axiomatic that, if we are to obtain the maximum fatigue resistance, residual compressive stresses must be present in the surface. These compressive stresses may be obtaind in two ways, by thermal means such as proper type of quench, flame hardening or induction hardening, but in these cases a sufficiently low drawing temperature must be used to prevent release of the favorable initial surface stresses, or by some form of cold working such as cold rolling. These methods will about double or more the fatigue limit stress at which the axle or pin will break off within the press fit. Shot peening, metal spraying and other methods of preparation have been found beneficial and still others are under constant investigation. While the values cited here generally apply to parts of plain carbon steel there is some limited data on alloy steels. Indications are that practices found beneficial for the carbon steel will also generally prove advantageous if alloy steels are used. In the meantime many of the results of this research are being applied in service as a final correlation with the laboratory findings.

Metal Limitations in the Perfecting of Motive Power

*By Paul Irwin**

The greatly expanded production of magnesium and aluminum will certainly invite the use of these metals and their alloys in transportation equipment after the war, although their application in steam and Diesel locomotives will probably be limited to cab frames, crosshead gibs, streamlining and other low-stressed parts.

For highly stressed parts, and parts in which light weight is an important factor in reducing unbalance, the high-alloy steels will undoubtedly be used again. Such parts include main rods, side rods, axles, pistons, piston rods, crossheads and boiler plate. In Diesel locomotive engines they would include connecting rods, connecting

* Engineer of tests, Baldwin Locomotive Works, Philadelphia, Pa.

rod bolts and fuel injection equipment. Highly stressed parts working at higher temperatures, such as superheater bolts and valve parts, will undoubtedly be improved by the use of better creep-resistant materials. The power of Diesel engines, for a given size and weight, could be greatly increased if material for pistons, capable of withstanding much higher operating temperatures, could be obtained. The present materials for such high temperatures are very difficult to machine. Recent metallurgical advances associated with the development of high-temperature materials for gas turbines may be modified for such applications.

The failure of locomotive parts is almost invariably associated with fatigue cracks. Within reasonable limits we know that the endurance limit is associated with the tensile strength; therefore we should increase the tensile strength even though elongation and Izod are somewhat reduced, due consideration being given to notch fatigue strength. It is strongly recommended that careful consideration be given to a gradual increase of tensile strength to provide better fatigue resistance wherever experience has shown a tendency toward fatigue failures.

The quality of steel castings, iron castings and nonferrous castings has gone through an extremely rapid evolution during this war period. Primary credit should be given to the insistence of the armed services upon high quality castings and their reliance upon radiographic and magnetic inspection as required inspection procedure. Having learned (sometimes forcibly) the value of radiography in the production of sound castings, I believe that most plants having such equipment will continue to use it after the war.

The strength requirements of heavy locomotive forgings, such as axles, main rods, side rods, Diesel crankshafts and camshafts, make it imperative that the steel be reasonably clean, free from non-metallic inclusions, residual pipe or any discontinuity that lends itself to the inception of fatigue cracks. The difficulty in obtaining metallurgically clean billets for large crankshafts has forced some manufacturers to the use of cast-steel or cast-iron parts. Experience has shown that when a given foundry has developed the technique of producing a sound casting to a given pattern, all subsequent castings to that pattern will be uniformly sound. In the case of forgings, this situation does not hold because the forging manufacturer may have clean billets one week and dirty billets the next. In any design for tomorrow, our forgings for motive power must be made of steel of greatly improved quality.

Plate material for weldments is playing a very important part in the transportation industry; welding technique has been markedly improved; important weldments are Magnafluxed and X-rayed. However, a great deal of trouble has been encountered due to badly laminated plates which inevitably produce artificial cracks and other defects in the weld. We have found this to be true in expensive, highly alloyed plates, as well as in the better grades of carbon-steel plate. Improved welding techniques are nullified if the best material contains such serious defects. Plate laminations are probably the result of pressure on the steel mills for astronomical tonnages but every effort should be made to bring the quality up to prewar standards, or better, as soon as possible. One serious limitation in the design of steam-locomotive boilers has been the prevalence of corrosion cracking that is associated with the higher strength steels. This limitation will be completely removed, based upon present evidence, when the all-welded boiler is the rule rather than the exception.

In our designs for tomorrow, increased speed will be mandatory. Increased safety must also be stressed. The record of the United States railroads, in this respect, is good; we have found that use of radiographic and magnetic testing has reduced service failures of locomotive parts to a minimum. In the opinion of the writer, both increased speed and increased safety can be achieved by the continued diligent use of magnetic and radiographic inspection and the application of known methods of avoiding fatigue failures.

Helical springs of large-diameter wire have failed too frequently due to decarburization and wire-drawing marks. This constitutes a serious limitation in the design of large helical springs for locomotives and tenders. Valuable metallurgical advances and processing techniques, such as shot blasting, will markedly improve the endurance limit but such advances are completely nullified if the processing of the bar stock and the heat treatment of the springs are not properly executed. Some of our eminent metallurgists have frequently criticized the railroad industry for failure to take advantage of new metallurgical and processing techniques. Our answer is that voluminous experience has shown that we must start with a basically sound material and processing and heat treatment must be properly executed before some of the newer developments can be safely applied.

Other things being equal, cost will always be a limitation in the design of motive power. We are continually seeking to reduce the weight of many parts of the steam locomotive and a reduction in weight usually implies an increase in strength and increased strength usually implies the use of comparatively expensive alloys and more expensive heat treatments.

Incipient Cracking in Firebox and Boiler Steel

By Ray McBrian*

When discussing the subject of detection and prevention of incipient failures in firebox and boilers, it should be realized that in service the boiler and firebox undergo a stress cycle each time the locomotive is fired. Also that stress cycles occur from drifting operations, by feedwater passing over hot metal intermittently, and from cool-down operations in washing the boiler. These service stresses greatly influence the life of the materials and contribute to the causes for incipient failures.

The types of materials used by the railroads are the plain carbon steels, so-called silico-manganese steels, the nickel steels, and carbon-molybdnum steels. Records to date of all the materials indicate that there have been service failures and no one material has been found which will meet all of the requirements and eliminate failures.

Complex service stresses give rise to a number of failures which must be recognized. They may be from aging or embrittlement, fire cracking, corrugations, corrosion fatigue, fatigue from fabrication stress-raisers, and from the composition of materials and their properties at elevated temperatures, especially in the blue brittle range.

The phenomena of the aging of steel has been and is the subject of study, and it seems that all such terms as strain aging, carbon aging, temper brittleness, blue heat brittleness are used to designate or describe similar effects. To us, aging simply means that phenomenon which occurs under service conditions resulting in a loss of ductility and subsequent failure. Aging characteristics

* Engineer of standards and research, Denver & Rio Grande Western, Denver, Colo.

are determined by the tensile test on material removed from service, and the possibilities of material which may age in service can seemingly be predicted by making elevated temperature tests. The yield point and tensile strength curves of materials which show a rapid rise or high peaks through the blue brittle range can be expected to be aging materials. Rimmed steel seems to be very susceptible to aging.

The explanation of fire-cracking seems to be that when steel is heated from room temperature to 1,000 deg. F., it lengthens by approximately seven parts per thousand. If it is restrained from lengthening, as in the case of a locomotive firebox rigidly held by staybolts, it must go into compression or free itself in some other way. For example, a locomotive firebox sheet under 200 lb. pressure is at a temperature of from approximately 380 deg. F. on the water side to a skin temperature on the fire side of 1,000 deg. F. Therefore, the fire side tends to expand more than the water side, and the sheet tends to bow out between the restraining staybolts. Even this does not relieve all the compression since the yield strength of the fire side skin is low at the temperature involved. On cooling, the fire side surface is in tension, and the surface tends to crack just as does a tensile specimen.

With a sheet having a decarburized surface, this action develops fatigue cracks of a nature which can be identified by a ginger-bread appearance. The condition of the surface skin, or rather the depth of decarburization, influences the tendency to crack both on the fire side and water side of a firebox sheet. These cracks between staybolts can be detected in their earlier stages by Magnaflux and later visual inspection. They can and do occur in the absence of leaks. One of the solutions for this problem has been through the use of carbon-molybdenum steel where the molybdenum has strengthened the ferrite surface. Obviously another is the study of circulation to relieve the so-termed hot spots.

Associated with the temperature effect is the problem of corrugations which can be described as deformations due to stresses occurring during firing and from the low physical strength of the material at operating temperatures. The danger of corrugations is of scale accumulations in the depressions which can result in serious overheating. Our solution to this problem is to use a carbon-molybdenum steel which supplies the added strength necessary at operating temperatures.

With the problem of the firebox material is associated that of the staying material, or the staybolt. The types of material generally used by the railroads for this service are double-refined wrought-iron, and steel. With steel staybolts, failures can occur from aging. The boiler inspector usually finds these when, upon tapping the head of the staybolt, it breaks like glass. Physical tests then confirm the aging. Also, with steel staybolts, the decarburized surfaces result in progressive fatigue cracks developing, and rapid crack propagation, especially if the boiler water is corrosive, and aging is present. Brittle breakage has occurred in wrought-iron staybolts, and, upon examination, nitride needles have been found in the structure. This nitrogen content was the contributing cause of failure. With both the steel and wrought-iron staybolts, fatigue failures occur in the threaded area usually from the root of the thread. There is need for further study of threaded materials and means to reduce stress concentrations.

After 3½ years, our staybolt breakage has been greatly reduced by the use of molybdenum wrought-iron. We have not had a broken radial bolt made of this material.

In boiler and fireboxes fabrication practices are most important as contributing causes for failures. This is especially true since our materials are operating in the blue-brittle range. The problem of stress raisers is therefore associated with that of temper brittleness. Boiler-shell failures can occur from a combination of service stresses, stress raisers and temper brittleness of the material. In addition to this type of failure is that of the intergranular type, usually called caustic embrittlement, of which we have had very little in locomotive boilers. I might say that, from the service records of alloy steels available, they appear to be more susceptible to notch sensitivity and rapid crack propagation. Consequently some of the railroads have foregone the possibilities of weight reduction by continuing the use of plain carbon steels. We need to learn more about the notch sensitivity of alloy steels especially under operating temperatures, and we must bring out to the fabricators, the importance of more care in handling alloy materials.

Along with the failure of boiler sheet materials is that of rivets. Rivet failures by many is interpreted as evidence of caustic or intergranular corrosion. However, another cause can be that of temper brittleness or a brittle condition left in the rivet after either cold or hot working. This brittleness can also come from too low a carbon content with the rivet material bordering on ingot iron.

Radiographs using either radium or X-ray can be utilized for the detection of cracks in boiler seams. Radium is portable and can be more easily adapted. Magnaflux methods can also be used both for detection of surface cracks in the boiler and firebox materials and for detection of laminations in plates with drilled holes and along the edges. Thermoflux methods for measuring heat dissipation through a sheet can be used for the detection of laminations in plates. This same method using coatings which change in color at various temperatures can be used to detect laminations or badly segregated areas.

In general, it may be said that in the future construction of locomotives, fully killed steel should be utilized in all firebox and boiler materials. Decarburized surfaces should be avoided if possible. Designers must understand the properties of the materials they specify at the actual operating temperatures. Fusion welding of boilers with proper stress relieving will eliminate the so-called caustic or intergranular type of failure.

Modern inspection methods using X-ray, radium, Magnaflux, and Thermoflux may be employed to detect or prevent incipient failures in boiler and firebox materials.

Improving the Railroad Car Bearing

*By J. R. Jackson**

The present-day standard A. A. R. journal-box assembly, of which the bearing is one part, is substantially the same as the assembly of 70 or more years ago. The parts have simply been increased in size with the adoption of the standard axle sizes. The bearing is and for many years has been a cast-bronze back having a white-metal lining soldered thereto—a bearing carrying the load through the crown and taking the lateral thrusts at the ends through the wedge and journal box. It is not a fitted bearing but must adapt itself to the diameter and contour of the journal on which it has to run and function with the component parts of the journal-box, wheel and axle and truck assembly of the running gear of the car,

* Engineer of tests, Missouri Pacific Lines, St. Louis, Mo.

(*Continued on page 563*)

What Causes Plugged Nettings*

By R. A. Parker†

Plugging caused by crowding the fire to restore pressure lost by bad fuel distribution

R. A. Parker

At the time we started the study of plugged nettings we were under the impression there were two distinct types; namely, where the coating appeared to be of a tarry substance, and the other where the coating appeared to be of a brittle, cement-like texture; we have concluded there is but one type, which is the result of carry-over from the firebox of coal in different stages of combusion. Inspection of the accumulation in the progress of plugging the netting disclosed varied appearances.. A netting plugged for a period sufficient to allow for fly ash and carbon from smoke to adhere thoroughly will present the appearance of being plastered.

What Causes a Plugged Netting?

While there are many contributing factors, the most common cause of plugged netting is the condition of the fire. The fire may be heavy in the front portion of the fire box and thin in the back. The same condition applies to the reverse, or the fire may be thin through the center of the firebox; in other words, any condition which restricts the draft through any portion of the fire, thus creating an abnormal draft through other portions of the fire. This may be caused by slipping the drivers, thus setting up a condition through which there is a possibility of holes being torn in the fire bed; it may be caused by a hard steaming locomotive which the fireman in his efforts to maintain boiler pressure is liable to over-fire.

Another cause is inadequate effective front-end netting area, or appliances in the smokebox which retard the effectiveness of the locomotive exhaust in cleaning the smokebox of carry-over.

How Plugging Occurs

Should the fire become heavy in any portion of the firebox, an increased draft will result through the thin portions of the fire and during the period of filling up these thin portions, this increased draft results in an unusual carry-over to the front end. This is particularly true with the locomotive working to capacity. The netting becomes plugged apparently for the reason that there is insufficient effective netting area to handle the abnormal carry-over at such a time.

To substantiate this, in our tests we built the fire heavy in front by increasing the stoker-jet pressures and at the same time allowing the fire on the back portion of the firebox to become very light. We allowed the locomotive to continue working at capacity until the boiler pressure had dropped close to 175 lb. Then, by decreasing the jet pressure the fire was built up where it was light and at the same time the stoker was crowded to the extent of making dense black smoke at the stack. We were thus able to increase the carry-over from the firebox to the front end to the point that it apparently could not be handled by the netting and we were able to plug it. By the same process, with the fire too heavy at the back and light at the front, we were also able to plug the netting.

The netting starts to fill up at the top and the accumulation progresses downward until the netting is completely covered. When the coating is finally solid, the boiler pressure drops very rapidly and cannot be raised until the netting has been cleaned.

In our tests the distance traveled from the time we started to try to plug the netting until we had it accomplished varied from 35 to 70 miles.

With our Class L-2 locomotives it was our experience that when the boiler pressure was in close proximity of 175 lb. we could most readily plug the netting. Unless the velocity of the cinders traveling to the front end was reduced proportionately with the drop in boiler pressure and, coming in contact with the netting, the force was not great enough to break them up so as to pass through, I am unable to explain the relation of the boiler pressure to the netting plugging. A hard-steaming locomotive in itself would probably not contribute to a plugged netting, yet the fireman in his efforts to maintain boiler pressure is very liable to overfire such a locomotive and in so doing might create a carry-over to the point of plugging.

Necessary shaking of grates to maintain a good fire does not, in my opinion, contribute to the netting coating over. But vigorous shaking of the grates is not desirable, especially when the locomotive is working at or near capacity, because it results in a considerable carry-over to the front end and may cause thin spots or holes in the fire. Correcting this may result in a further carry-over sufficient to start coating of the netting. Therefore, it is preferred that the grates be rocked gently and often.

It is possible to have ample netting area to take care of the carry-over, but if the direction of circulation in the smokebox is not right, it renders a portion of the netting area ineffective. It is also desirable to eliminate from the inside of the smokebox as much piping as possible. For the purpose of our test we located the exhaust-steam supply pipes to the feedwater heater outside the smokebox and changed the blower pipes to enter from the top instead of from the side of the netting box. Considering the very high speed of the gases, undoubtedly a slight obstruction causes serious eddies and interferes with the flow of the gases.

The fireman normally has adequate time after leaving the ready track at the enginehouse until leaving the yard with the train to prepare his fire, which he does leaving

* From a paper prepared for the 1944 year book of the Railway Fuel and Traveling Engineers' Association.

† Supervisor Fuel and Locomotive Performance, New York Central.

the house and in the yard by adding coal as necessary with the scoop shovel. On leaving with the train he normally has a good firebed built up and burning brightly with full boiler pressure and an ample water level.

The period of getting the train under way leaving the terminal is one during which both the engineman and fireman should be very much on the alert as this is a time when they are most susceptible to getting into trouble. During this period it is essential that the fireman watch his fire closely to know that he is getting the desired amount and distribution of coal over the fire and to regulate the stoker as to the amount of coal and the jet pressures required for proper distribution to maintain a fire void of thin spots. The engineman should avoid slipping which has a tendency to tear holes in the fire.

Should the fireman at any time have trouble in distribution, he should notify the engineman so that he may ease on the throttle or work the locomotive a slightly shorter cut-off while the fireman corrects the distribution. There may be times when both will be found desirable or necessary.

Metals for The Railroads

(*Continued from page 561*)

all parts being subject to relatively large manufacturing tolerances and wide wear limits before being condemnable. The tolerances and limits are based on the accumulated experience of many years.

There are those who advocate specifying anti-friction bearings for all new railroad equipment to be built from now on and progressively changing over all existing rolling equipment to anti-friction bearings during the post-war period. This is a large order, in my opinion not an impossibility but rather an improbability because of the financial burden on the railroads this program would entail and question as to the validity of the claims for anti-friction bearings in interchange service from a mechanical and performance standpoint.

The matter of application of anti-friction bearings to freight equipment is being studied by a committee under the A. A. R. and some progress has been made towards standardization of truck and box dimensions with a view of interchangeability of the bearings of designs developed by the different anti-friction bearing manufacturers.

If we disregard interchangeability or adherence to present practices there are a number of things which might be done with a view of improving the present crown-type, steeple-backed, lined bearing. Among other possibilities are: removal of present standard thrust collars on the outer ends of axles, thus permitting the use of a sleeve or semi-sleeve type bearing elimination of the present conventional waste pack used for journal lubrication and provision of an oil-tight journal-box permitting of flood or bath lubrication, thereby eliminating the possibility of a waste grab as a cause of lubrication disturbance in the present assembly; redesign of the entire truck and journal-box assembly for use on freight cars, employing the pedestal type and separate journal box of the type now generally used in passenger service. Considerable progress has been made in this field as evidenced by the numbers of truck and journal box modifications which have been experimented with and have accumulated some service background during the pre-war era.

Activities in the refinement of design and manufacture of present bearing and associated parts, retaining interchangeability with present standard parts, have been considerable during the past 15 years. A rather comprehensive research program under the direction of an A. A. R. Committee on Journal Bearing Development has been under way since early in 1942. The results of the development and research in this field have made available many of the pertinent facts relating to both the possibilities and limitations of progress in this direction.

The set-up of railway mechanical forces at car repair and servicing points has grown through the years and is established through labor agreements and cannot be readily changed. These forces are not schooled in handling precision mechanical work but are experienced in handling relatively rough operations involved in the repairs to and maintenance of the present rolling equipment.

The present A. A. R. standard car journal bearings and associated parts in service and in stock on the railroads of the country represent a very large investment in material. To alter the present design of bearing materially would necessitate changes in other related parts of the journal box assembly and would truly constitute a major operation, result in confusion during the transition period, and would require a large expenditure on the part of the railroads. Any mechanical design, to be continued essentially without change for over 50 years on the railroads of this progressive country has to be reliable and efficient. Any changes in design looking towards improvement in the car journal bearing will have to be analyzed from both the practical and economic viewpoints.

I do not mean to infer from the foregoing that the present design of railroad car journal bearing is perfect and that, therefore, there is no room for improvement. My purpose is to point out some of the factors which have to be considered in our problem of improving the railway way car journal bearing during the post-war period.

This leads us to the question from what direction can improvements in the present car journal bearing for interchange service be looked for after the war. Three possibilities are open:

1—General adoption of anti-friction bearings.

2—Redesign of solid bearing and associated parts of the present journal-box assembly without regard to interchangeability with present standard parts.

3—Refinement of design and manufacture of present bearing and associated parts, retaining interchangeability with present standard parts.

* * *

U. S. Army from British Combine

Tank cars destroyed by U. S. Army Air Force bombers at Gennevilliers, near Paris, during the June fighting in Normandy, when the enemy lost 13,000 tons of oil

Fire–Air–Water*

Lawford H. Fry

By Lawford H. Fry†

A discussion of the "linked triangle" of the steam locomotive combustion train – Drafting locomotives is not yet a science

Combustion, like quarrels which also engender heat, is a dual affair. The fuel taken from the tender burns by combining with the oxygen of about 10 lb. of air for a pound of coal or about 15 lb. of air for a pound of oil. It is natural that the coal or the oil which has to be paid for should be considered as of first importance, but for success in combustion, very careful attention must be given to the air. From our point of view the air is burned just as much as the coal is. Of course in the case of the coal, it is only the combustible part and not the ash that burns, and in an exactly similar way it is only the oxygen and not the nitrogen of the air that burns. For convenience though, we speak of a pound of air being burned when what we mean is that the oxygen of that pound of air has entered into chemical combination with the combustible of the fuel.

In the locomotive boiler we have what the present writer has called a "linked triangle of fire, air and water." The fire evaporates water to produce steam, while the steam escaping through the exhaust nozzle induces the flow of air which feeds the fire. By letting more steam go through the cylinders to the nozzle more air is drawn through the fire to generate more heat to produce the greater quantity of steam required. This sequence is well known and we are all also familiar with the fact that, like Harry Leon Wilson's Cousin Egbert, it can be pushed only so far. There is a limit to the extent to which steam production can be carried. It is pretty well understood that as the boiler is driven a point is reached at which an increase in the rate of steam flow through the exhaust nozzles fails to produce an adequate increase in the air supply.

The reasons for this are of great importance in the design of boilers, but definite figures on the subject have not been published. The present study is made to throw some light on the actions taking place. The questions involved concern the relation between air supply and heat produced on the one hand and the relation between steam exhausted and air entrained on the other hand. The first thing to note is that with a given fuel the heat produced per pound of air burned is just as definitely fixed as is the heating value of the fuel, which of course is the heat produced per pound of fuel burned. In the example dealt with in the Appendix, the heat released per pound of air burned is 1,350 B.t.u.

The heat required to produce a pound of steam of given quality is of course also a fixed quantity and the upper limit of the boiler capacity is reached when a pound of steam exhausted through the nozzle just succeeds in bringing in enough air to burn and to release the heat required to evaporate the pound of steam.

It is interesting to use a set of test data to illustrate how this balance occurs. Computations in the Appendix are based on a coal-burning locomotive with an exhaust-steam feedwater heater. The relation between the weight of air drawn through the fire and the weight of steam exhausted through the nozzle is shown in Fig. 1. The tests from which this information is derived show that the maximum capacity of the boiler is just about reached with an evaporation of 98,000 lb. of steam and a firing rate of 180 lb. of coal per sq. ft. of grate per hour. At this rate of evaporation 1.54 lb. of air are supplied per pound of exhaust steam, and the computation in the Appendix show why with a falling ratio of air supply to steam the evaporation cannot be carried much higher.

Put briefly, the fact is that for delivery of one pound of steam to the exhaust nozzle at this rate of operation we must have 1,830 B.t.u. released in the firebox, and that each pound of air burned releases 1,350 B.t.u. It is

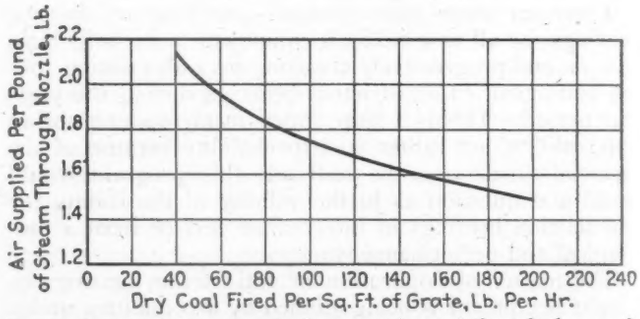


Fig. 1—Air supplied per pound of steam exhausted through the nozzle in relation to firing rate

therefore necessary to burn 1,830/1,350 = 1.37 lb. of air to produce one pound of steam at the nozzle. The test results show that 1.54 lb. of air are supplied which means that of the air supplied only 8.6 per cent escapes unburnt. If more steam were to be exhausted the weight of air supplied per pound of steam would drop to a point at which the heat released by the combustion of the air would not be sufficient to produce the steam.

The Air-Coal Relationship

As a matter of fact it would be practically impossible to reach the point at which 100 per cent of the air supply had to be burned and it is uneconomical to approach it too closely. In the case we have been considering with only 8 per cent of the air unburnt the loss by unburnt fuel is about 25 per cent which is a relatively low figure. Tests with other boilers at comparable rates of combustion generally show considerably higher unburnt fuel losses.

When we consider the condition under which combustion takes place in the firebox it becomes obvious that 100 per cent combustion of the air is impracticable. This

* From a paper prepared for the 1944 year book of the Railway Fuel and Traveling Engineers' Association.

† Director of Research, The Locomotive Institute.

would require that during its rapid travel through the firebox every atom of oxygen should come into contact with an atom of combustible matter. The only way to achieve this would be to slow down the passage through the firebox or to have a large excess of unburned fuel. As the percentage of excess air decreases the rapidity with which the air finds opportunity to burn is slowed up by what the chemists call "mass action."

At moderate rates of firing with considerable excess air combustion takes place rapidly with a moderate amount of excess combustible and a reasonable efficiency of combustion is obtained. On the other hand as the steam production is increased the weight of air per pound of steam decreases although the total amount of air increases. This means that to produce the heat required for a pound of steam less air is available and consequently a higher percentage of the air present must be burned. Furthermore the burning must take place more rapidly because of the more rapid flow through the firebox. This combination of high efficiency of combustion of the air at a rapid rate of combustion can be obtained only by having a large excess of combustible present. That is, by having a low efficiency of combustion of the fuel.

In this connection it is well to note that it is better to speak of the air supplying the free oxygen as "unburned air" rather than as "excess air" as is sometimes done. At the higher rates of combustion in spite of the appearance of free oxygen corresponding to unburned air the total amount of air supplied is insufficient to burn all of the coal fired. In the high evaporation tests quoted the air supplied per pound of dry coal fired was only 8.8 lb. while the air required to burn a pound of coal was 10.38 lb. There was no "excess" air in the proper sense of the term.

Before leaving the question of the percentage of air passing unburnt through the firebox it is of interest to call attention to Fig. 2. This shows the unburnt air as a percentage of the air supplied in relation to the rate of firing. The values are derived from the same series of tests as that on which the computations in the Appendix are based, but are obtained from other data by an entirely different method of calculation. The values determining the line in Fig. 2 depend only on the relation between the amounts of free oxygen and nitrogen in the smokebox gas analysis. The volumetric percentage of nitrogen, N_2, is proportional to the total weight of air supplied while the percentage of free oxygen, O_2, is proportional to the weight of unburned air. From these relations we derive the fact that the weight of the unburned air expressed as a percentage of the total air supplied is equal to $377 \times O_2 \div N_2$, where O_2 and N_2 are the volumetric percentages of the respective gases found in the dry products of combustion.

The figures used in the Appendix are based on different data and a much more extended chain of calculation. This uses the data as to coal fired, steam produced, and smokebox temperature as well as the complete analysis of the smokebox gases to set up a heat balance and to find the weight of carbon actually burned per pound of coal fired. Then the complete analyses of the coal and of the smokebox gases are used to determine independently the weight of air supplied per pound of carbon burned. These values for the weight of carbon burned and for the weight of air supplied per pound of carbon burned taken together give the total weight of air supplied in pounds per hour, which is the basis for the curve in Fig. 1. The two points in Fig. 2 which plots the relation between unburned and total air were obtained by computing the total air supply as described above and then finding the weight of air burned by the method illustrated in the Appendix. When it is considered that they are obtained by entirely dissimilar methods the agreement between the points and the line in Fig. 2 must be considered as very satisfactory.

The Air-Steam Link

The Appendix shows two sets of computation, one for the high rate of evaporation which we have discussed and the other for a steam production of about 40,000 lb. per hour with a firing rate of about 60 lb. per sq. ft. of grate per hour. At this rate the superheat is lower so that a pound of steam can be produced by the heat released by 1.34 lb. of air. Fig. 1 shows that the nozzle

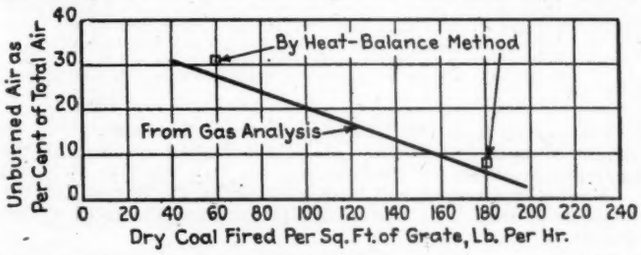


Fig. 2—Unburned air per pound of total air in relation to rate of firing

supplies 1.95 lb. of air per pound of steam so that the air escaping unburned is 31 per cent of the total air supplied. With this excess air the efficiency of combustion is improved and the loss by unburned coal, which was 25 per cent, is reduced to about 16 per cent. The greater amount of unburned air raises the loss by sensible heat in smokebox gases from about 14 per cent at the high rate to about 15 per cent at the low rate of combustion, but this slight increase is more than offset by the gain in efficiency of combustion.

The figures that have been developed show that the reason for a ceiling on the capacity of a locomotive boiler is that the exhaust nozzle loses in efficiency as the boiler is forced and draws in less and less air per pound of steam, until the burning of the air drawn in by a pound of steam does not produce enough heat to generate a pound of steam.

At this point it may be well to emphasize the fact that the heat released by the combustion of one pound of air is dependent only on the analysis of the fuel and is not affected by the amount of excess combustible which escapes unburnt. It may also be noted that the amount of heat released per pound of air does not change greatly with a change in fuel analysis. With the bituminous coal of 14,000 B.t.u. heating value a pound of air releases 1,350 B.t.u., while with an oil of about 18,500 B.t.u. per pound the heat released per pound of air will change only to about 1,400 B.t.u.

The figures that have been developed show clearly that the declining air supply to the firebox is the factor which lowers boiler efficiency as the boiler is pushed and sets a ceiling on steam production. The air supply is dependent in the first place on its motive force which in the conventional boiler is the steam through the exhaust nozzle. Extensive studies have been made of the nozzle and of the front end, but arrangement of the draft apparatus is still an art rather than a science. Every designer has his rules, but none will claim to have established the fundamental laws governing the problem. Until these are established we have not done our whole duty by the steam locomotive.

Study of the theme that has been developed here should be helpful. It will lead to the realization of the importance of ample firebox volume in which combustion can take place and of large gas area through the flue bundle to

facilitate the induction of air. Attention may also be profitably directed to consideration of the downward slope of the air-steam line in Fig. 1. Raising this by obtaining more air per pound of steam will add to efficiency and capacity. In this connection study and research along the lines of over-fire air and of mechanically induced draft may yield good results.

Appendix

The appendix presents data and methods of computation to illustrate the relation between air supply and combustion conditions.

Fuel

Fuel is assumed to be a bituminous coal with about 39 per cent volatile and 55 per cent fixed carbon with the following ultimate analysis, in per cent:

Carbon	77.7
Hydrogen	5.3
Oxygen	7.4
Nitrogen	1.6
Sulphur	2.0
Ash	6.0
Total	100.0

The oxygen is assumed to be combined with one-eighth of its weight of hydrogen leaving $5.3 - 7.4 \div 9 = 4.4$ per cent as the hydrogen available for combustion.

Weight of air used and heat released by the burning of the combustible matter of one pound of coal are found as shown below:

Combustion

Weight of combustible per pound of coal

Carbon	0.777 lb.
Available hydrogen	0.044 lb.

Weight of air required for complete combustion per pound of coal		Heat released by complete combustion per pound of coal	
$0.777 \times 11.43 =$	8.87 lb.	$0.777 \times 14540 =$	11,300 B.t.u.
$0.044 \times 34.3 =$	1.51 lb.	$0.044 \times 62000 =$	2,700 B.t.u.
Total	10.38 lb.	Total	14,000 B.t.u.

Heat released per pound of air burned $= 14{,}000 \div 10.38 = 1{,}350$ B.t.u.

Steam Production

The distribution of steam between feedwater heater exhaust nozzle and auxiliaries at all rates of evaporation is assumed to be constant in the following proportions:

	Per cent
Superheated steam exhausted to feedwater heater	13
Superheated steam exhausted thru nozzles	81
Saturated steam to auxiliaries	6
Total water evaporated by the boiler	100

Details of the heat released and heat used are worked out for a low and for a high rate of evaporation, with steam pressures and temperatures as shown.

Total evaporation, lb. per hr.	40,000				98,000		
	Wt. in per cent	Press., lb. per sq. in.	Temp., deg. F.	B.t.u. per lb.	Press., lb. per sq. in.	Temp., deg. F.	B.t.u. per lb.
Entering Boiler							
Water from tank entering heater	87	0	80	48	0	80	48
Steam from tank entering heater	13	5	250	1,167	25	350	1,396
Total	100	...	...	194	...	...	226
Leaving Boiler							
Saturated steam	6	250	406	1,202	250	406	1,202
Superheated steam	94	250	650	1,344	250	750	1,396
Total	100	...	...	1,332	...	...	1,382
Heat required from fuel per pound water evaporated				$1{,}332 - 194 = 1{,}138$			$1{,}382 - 226 = 1{,}156$

On the assumption that for all rates of evaporation the heat absorbed by the boiler is 82 per cent of the heat released in the firebox and that the loss by external radiation is 5 per cent of the heat utilized in evaporation and superheating, the heat released is 1.28 times the heat utilized. Taking this into consideration and also the fact that complete combustion of one pound of air releases 1,350 B.t.u., the relations shown below are established:

Rate of evaporation, lb. per hr.	40,000	98,000
Heat utilized per pound of water evaporated, B.t.u.	1,138	1,156
Heat released per pound of water evaporated, B.t.u.	1,455	1,480

and remembering that the steam exhausted through the nozzle is assumed to be 81 per cent of the water evaporated,

Heat released per pound of steam exhausted thru the nozzle, B.t.u.	1800	1830
Heat released per pound of air burned, B.t.u.	1350	1350
Pounds of air to be burned to produce one pound of steam at the nozzle, lb.	1.33	1.37
Air supplied per pound of steam through nozzle as Fig. 1, lb.	1.95	1.54
Air supplied per pound of air burned, lb.	1.46	1.12
Unburned air as per cent of total air supplied:		
(a) from previous item	31	8.6
(b) by gas analysis as Fig. 2	27	6

Colloidal Organic Boiler Feedwater Treatment

(*Continued from page 557*)

The saving of 10,100 to 13,180 gals. of heated water was made possible by use of the organic colloidal emulsion. On the same division blowdown of passenger locomotives was reduced from a range of 6,800 to 8,500 gals. per round trip to an average of about 618 gals. While cost calculations on different roads may vary, the saving of such quantities of heat-laden boiler water represents a major economy.

Locomotive Washings

Application of the organic colloidal emulsion on railroads has enabled enormously increased mileage of locomotives between washings. According to published data of the motive power department of the Latvian State Railways, locomotives in some districts increased their runs from 1,800 km. up to 12,000 km. and in others from 3,000 km. to 14,000 km. and over. This latter figure, about 8,750 miles, was accomplished using waters averaging 11 grains per gallon in hardness. Numerous test openings of locomotive boilers, many of which took place in the presence of special committees, showed that even after such prolonged runs, the condition of the boilers was considerably better than after the previous short runs without the all-colloidal organic treatment. Details of the use of this organic colloidal method since 1934 in locomotives were published in the Latvian Railroad Record and read at the Baltic and Scandinavian Railroad Conference in June, 1937, at Riga, Latvia.

In 1940, this organic colloidal emulsion was first used in locomotives of a mid-western short line railroad. Water fed at the terminals was treated in two different ways by two connecting railroads. The mixture of waters had resulted in very severe foaming, making it necessary to wash boilers each three to five days. Results with the organic colloidal emusion were immediate. Foaming was eliminated to the extent that the locomotives could be operated twelve to fifteen days and longer without washings. Scale, which had also been experienced despite the use of pre-treated waters, was reduced to mud which could be easily blown or washed out. Frequent internal inspections have constantly revealed all boilers to be in splendid condition throughout. During its 4½ years of organic colloidal treatment, the savings in time, labor and locomotive availability from eliminating an average of five washings per locomotive per month would make a very impressive figure.

Beginning in November, 1942, one of the major railroad systems in the United States tested the organic colloidal emulsion in a 4-8-4 locomotive on a standard run. The water used was Zeolite pre-treated, but due to the fact that the original water ran from 5 to 23 grains in hardness, total solids were high and foaming was commonly experienced. For this reason washings had been required each two days. During the one month test, the locomotive gave excellent performance at all times. It was opened after fifteen days and at the end of the test, not due to foaming but for inspection. It was found in excellent condition in all respects. Since February, 1943, this same system has been using this organic colloidal emulsion on a considerable number of locomotives, including those of the 4-8-8-2 type. It is applied in some localities as the full treatment and in others as after-treatment.

EDITORIALS

Penny Wise, Pound Foolish

Recently the director of engineering for a large manufacturer of railroad specialty equipment, in addressing a railroad audience which was familiar with the use of the equipment about which he spoke, undertook to explain in part why certain practices were recommended and why certain materials and designs were employed. His hearers were well acquainted with the functional requirements of the product and had a wealth of experience in its maintenance. Their response to the speaker's attempt to explain "whys" from the designing engineer's point of view indicated clearly that there is an opportunity for all manufacturers of specialty equipment to go a little further than the issuance of maintenance manuals when installing or applying their products.

Even the most experienced members of the audience could see more clearly the need for following the practices recommended by this manufacturer when they understood more completely the design factors which were involved in the recommendations. Seeing through the eyes of the engineer, they could understand why "good enough" or "the same thing" or "just as good" were not terms upon which any reliance could be placed. They understood also that although a number of sources of supply might exist, the engineer wanted an identical product from each which met the service requirement specifications set up to insure the functioning of particular equipment or parts of equipment at the maximum level of efficiency.

It would seem that the designing engineer and the user should not be far apart on their understanding of this problem since each is interested in obtaining maximum service at a high level of efficiency. Actually, however, it is at this point that they seem farthest apart because the user, while willing to admit that the engineer knows how to design, gives less credit to him apparently as knowing how to keep his equipment performing most satisfactorily. Minor increased difficulties in maintenance, lower initial cost of materials required for maintenance and, probably sometimes, favored-company purchasing tend to undo much that the designers and laboratory technicians have done in service testing their equipment and in resolving the problems of maintenance to minimum requirements for maximum return.

That this condition prevails is evident from the attention which the A. A. R. is compelled, from time to time, to direct to recommended standards or practices of its own. Although these standards occasionally result from the work done by individual manufacturers or groups of manufacturers, they are not incorporated in the practice manuals until they are found to represent the thought of responsible committees which have studied the problems involved entirely from the railroad point of view.

Asking that recommended procedures be followed certainly is not intended to prevent any railroad from adopting practices which are demonstrably better; in such cases the standard can be changed to include factors of improvement. But the use of obviously inferior methods or materials and reliance upon those of doubtful and unproved merit when standards are available is certainly wasteful and inefficient.

Isn't This Market Worth Special Effort?

In a recent discussion with a chief mechanical officer of a large railroad concerning the question of machine tools and shop equipment the remark was made that for several years past representatives of the many manufacturers who could supply that type of equipment to the railroads have been noticeable by their absence and that it is only within the past six to twelve months that machine tool salesmen and service engineers are beginning to show up again in the reception rooms of mechanical department offices. In discussing this situation this officer told of a recent incident in which a salesman representing a well-known machinery manufacturer called on a routine visit and was asked whether his particular machine was adapted to the quantity production of locomotive crank pins and, in reply, the salesman countered with the remark that if he knew just what a locomotive crank pin was he would be in a better position to furnish the information.

The above incident is not fiction; it is an unfortunate fact and in it lies a very important lesson both for the manufacturers and for the railroads. For, in the unpreparedness of that particular sales representative to answer a question relating to the qualifications of his product to do a customer's work lies the basis of an attitude on the part of far too many manufacturers with respect to the needs of the railroads. With other industrial markets representing more fertile fields they have too often considered the railroad shops as not being worth much effort. Having taken such an attitude they have denied both themselves and the railroads an opportunity to be of mutual service.

Possibly a few facts may be helpful in gaining a better perspective. First, and extremely important, is the fact that motive-power and rolling-stock repair work represented an expenditure of nearly 950 million dollars in 1943. Locomotive repairs alone accounted for over 500 million dollars. More than 60 per cent of this sum was spent for labor in back shops and engine terminals—the rest went for materials and supplies. It has been

conservatively estimated that somewhere in the neighborhood of 30 to 35 million dollars was paid out in wages to the operators of machine tools in shops and enginehouses. It has also been estimated that the total value of railroad machine tools is between 350 and 400 million dollars and that the *average age* of these machine tool units is between 25 and 30 years. It does not take much stretching of the imagination, on the part of anyone familiar with modern shop equipment, to come to the conclusion that certainly at least one-half to three-quarters of all of this shop equipment is definitely obsolete.

If these facts do not indicate a drastic need on the part of the railroads for equipment which the machine tool industry is ready and able to supply, then our appraisal of the present situation is greatly in error.

The railroads have money with which to rehabilitate their shops and reports from many sources reveal that road after road is in the process of developing extensive programs involving the expenditure of several million dollars, not only for comprehensive shop improvement projects but for the construction of new shops and engine terminals as well.

There is every reason to believe that when the reports are in for the year, 1944 will prove to be one of the largest shop-equipment-buying years on the part of the railroads for many years and so far we believe we are correct in saying that this past year's purchases of this character have been *bought* by the railroads and not *sold* by the manufacturers. There is plenty of evidence to substantiate this.

From now on the competition for every dollar that a railroad has to spend will become increasing keen. Those whose future prosperity depends upon finding new and broader markets for the type of machine tools and shop equipment that the railroads need should remember that the average railroad organization does not number among its staff members very many specialists in the application and economics of modern machine tools and tooling equipment. A railroad's job is to furnish transportation and today the burden that must be carried by the repair facilities at shops and terminals is greater and of vastly more importance than ever before in railroad history.

The mechanical officer previously referred to said in concluding his remarks that one of the most difficult problems with which he is confronted today is the lack of information as to the capabilities of modern machine tools without which it is virtually impossible to go to his management and get the necessary appropriations for new shop equipment and that he could not understand why the manufacturers could not, either individually or jointly, develop a group of sales engineers whose knowledge of railroad shop work and the problems of railroad management would qualify them to assist mechanical department men in modernizing their repair plants.

The rewards, in the next few years, would seem to be such as to justify the effort.

Decoration of Passenger Cars

When word was received early last month that the War Production Board had allocated material for 40 aluminum and 15 steel passenger cars to be built at the American Car and Foundry Company's plant, St. Charles, Mo., railroads were accorded the first tangible recognition of their urgent need for additional new passenger equipment. That the volume of this construction work will in all probability tax the capacity of passenger-car builders for a period of several years after the war has already been pointed out in these columns.

Structural materials and fabricating methods are already pretty well developed, as a result of intensive development of streamline trains during the last ten years, which means that passenger cars of the future will differ primarily from the more recent types now in service only in refinements of design and improved interior equipment and service features. The trains of tomorrow will undoubtedly offer intriguing combination of color and design, each assuming an importance not fully appreciated in the past.

The interior designer and consultant on color schemes and materials has encountered a certain amount of opposition in individual instances in the past, because he tends to upset and object to fixed procedures, obsolete styling and restrictions forced by existing production methods. Progressive railroads and car builders, however, now largely look to the designer and color specialist for sound planning, coordinated use of the many new materials coming from war developments and for the attainment of eye appeal and creature comfort which will assist in merchandising passenger service.

In future passenger cars, design will no longer be a matter of streamlining largely for appearance sake, but rather will be fundamentally planned from the earliest conception to be functional, appealing, workable and soundly engineered. Functional use will, to a great degree, be the motivating thought in design. A definite trend to smooth easily-cleaned surfaces devoid of superfluous ornamentation seems clearly indicated. Greater thought will be given to passenger comfort, ease of maintenance, ease of fabrication and to provide clean and simple walls and ceilings which serve as a background for the interior furnishings.

The indications are that color will not be regarded as incidental, but will become extremely important after the war. It is thought that the ten million service men and women who have for so long been regimented to indentical uniforms of identical colors will be anxious to express again their individual color tastes and enjoy color variety. They will undoubtedly be a major factor in giving impetus to a new color cycle in which stronger colors will replace soft pastel shades.

Trains will follow this post-war cycle and will use defined colors in place of soft tints. Interiors will be bright and colorful with focal or eye-arresting color fully blended with background color. It is said that reds will replace rust tones; blues will replace aqua-

marine; browns will replace beige; and color in general will be set in a much higher key.

It is also felt that exteriors will follow the same trend, with brighter colors for better visibility and personalized styling widely used.

Corrosion of Steel in Concrete

For the past two years the committee on electrolysis of the Electrical Section, Engineering Division, A. A. R., has been conducting a study of the corrosion of steel in concrete. The same group has also just about completed an extended investigation of the corrosion of materials used for overhead conductors. The procedure followed in the case of the overhead conductors consisted of suspending samples of a large variety of materials, respectively, in enginehouse jacks, in tunnels and in places where they were subject to salt atmosphere and locomotive exhaust gases. Samples were carefully weighed before and after exposure and the information obtained proved to be of great value.

The tests on the embedded steel, described in the 1944 Electrical Section reports abstracted in this issue, consist of placing one-inch round steel rods in various thicknesses and varieties of concrete, sinking the specimens into the ground, and applying a direct-current voltage between the specimens and ground.

There are differences of opinion concerning the causes of rusting, some maintaining that it is all due to electrolytic action and others that it can be simply oxydation. When it is electrolytic it may be local action through surface moisture between the metal and impurities within itself or it may be deposition of the metal due to a voltage difference between the metal and the surrounding material. Recent tests of soil corrosion of pipe lines made by the Bureau of Standards show that steels high in nickel and chromium, and copper alloys high in copper, are very resistant to nearly all soil conditions. A three-ounce coating of zinc added about three years to the life of steel exposed to some of the most corrosive soils, but lead coatings appeared to be inadequate for severe soil conditions.

In the tests conducted by the Electrical Section the possibilities of local electrolytic action or rusting is approximately the same in each case; and the amount of current flow, with the same voltage on each specimen, measures the protection offered by the concrete.

The tests have not been in progress long enough to warrant final conclusions, but some interesting data are already available. Evidently the thickness of the concrete has little if any effect on its protective qualities, and none of the admixtures tried have served appreciably to reduce the current flow, but exterior coatings of asphalt reduced it from about 50 to 90 per cent.

Air-dried Bakelite coatings applied to pipe in tests made by the Bureau blistered within four years. Those who have used asphalt for protecting steel underground may have some conception of its effectiveness and durability. The distinction of the Electrical Section tests is that the current flow gives a direct quantitative measure of the protection afforded against stray currents. Experience with reinforced concrete structures indicates that local electrolytic action or rusting of steel in concrete is of relatively little importance.

Spaciousness— A Factor in Competition

One of the notable trends in the public attitude toward railway passenger service is the apparently growing popularity of the de luxe coach trains which operate on fast schedules. For trains operating during daylight hours this popularity is not remarkable. The seats in the coaches are usually widely spaced so that not even the tall passengers are crowded. But the popularity of these trains does not extend to those moving in daylight hours alone, it includes the overnight trains as well.

A few years before the advent of the de luxe coach trains a tendency was shown by the railroads toward getting into a coach as large a number of seats as could be crowded in. This was done without too much regard for the comfort of the passengers. It is sincerely to be hoped that after the war no railroad will make the mistake of a return to that arrangement in new or rebuilt cars. The outstanding advantage which the railway passenger car has in comparison with the bus or the airplane is its relative spaciousness. Failure to capitalize on this will jeopardize the popularity of coach travel which current de luxe trains have built up. The difference between a seating capacity of, say, 60 and 80 may be the difference between success or failure.

NEW BOOKS

ELEMENTS OF MECHANICAL VIBRATION. *By C. R. Freberg and E. N. Kemler. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. 194 pages, 5½ in. by 8½ in. Price, $3.*

This book is elementary in character. As such, however, it is dealing with a field many problems in which can be solved only by using the methods of advanced mathematics. This book attempts to deal with those problems which can be solved by the simpler forms of differential equations, the approximate methods developed, or the mobility method which can be mastered by engineers and students without training in advanced mathematics. The problems which can be solved by these methods include isolation of equipment and determination of natural frequencies of a great many types of systems. Vibrations Without Damping, Damped Vibrations, Vibration of Systems with Several Degrees of Freedom, Vibration Isolation and Absorption, Equivalent Systems, The Mobility Method, and Mechanical and Electrical Models of Vibration Systems are the chapter titles.

The Maintenance of

Locomotive Air Compressors*

A. Malmgren, Chairman

By A. M. Malmgren†

Successful locomotive air compressor performance that is measured by the absence of delays or failures in service is dependent on the following major essentials, all of equal importance:

(1) Sufficient compressor capacity for the work to be done; (2) Air intake guarded by a filter which will prevent fine dust particles entering the air cylinders; (3) Continuous lubrication of steam and air ends of compressors while compressors are operating; (4) Proper testing and checking compressors at required intervals or before despatchment, observing and correcting any irregular operation and (5) When rebuilding compressors, putting into practice the better repair methods available and not being satisfied with just the minimum requirements; using the better materials now to be had with resultant longer compressor life between shoppings.

It may be well to stress that it takes good repairs, continuous lubrication and the exclusion of dirt from air cylinders and sludge from steam end to enable compressors to withstand, without damage, the unusually heavy work they are subjected to at times. Any one of these points will not suffice. Keeping fine dust out of the air cylinders is easily accomplished by using a filter which greatly increases the life of the air cylinders and packing rings at no additional maintenance cost. Continuous lubrication will overcome the ill effects of water and sediment that is carried into the steam heads and cylinders from overflooded or foaming boilers.

Compressor Capacity

The compressor capacity on a modern locomotive should be such that the greater part of the compressor work will be accomplished while idling, that is, running at capacity for only short periods of time with longer idling periods between. This will permit the usual high heat of compression to be reduced by radiation through the cylinder and head castings before the compressed air is discharged from the cylinders. Keeping the cylinders comparatively cool prevents destruction of the lubricant. Overheating is the usual cause for valve sticking and if dirt is present in the cylinders it will choke the parts and passages to the air valves, create abnormal wear of rings and cylinder walls and reduce the efficiency of the compressor.

The benefits derived from compressors delivering comparatively cool air may be traced in many directions, the more important being (a) to increase the overhauling charges due to parts being less worn; (b) to lessen the amount of water and gum deposited in the air-operated devices, and (c) to lengthen the time compressors are in service, often from shopping to shopping of locomotive.

It may be taken for granted that better compressor and brake efficiency will result with compressor capacity on locomotive sufficient to deliver air at a temperature always lower than the flash point of the lubricant. Leading authorities say a thin oil which has a high flash point and is free from carbon as conditions of lubrication will permit is the best oil for air cylinders. Cylinders which do not run the heat of compression up to the flash point of a good oil, require very little lubrication. It is better to run air cylinders as cool as possible which with added compressor capacity is more easily attained than to try to operate compressors of limited capacity successfully at high temperature.

Air Cylinder Filters

The new type air cylinder strainer employing a corrugated felt filter element is now generally known and its efficiency in keeping fine dust particles out of the cylinders has been proven. Railroads operating in dusty territory have found these filters real dividend earners, in that their use eliminated a "pump laundry" for washing air cylinders. In this dusty territory, with hair strainers applied to compressors of limited capacity, it is necessary in the dry seasons to use the pump laundry at each monthly inspection, at an estimated cost of $5.00 for each washing.

Dust and dirt drawn into the air cylinders destroy the lubricant and cause the packing rings and air valves to stick. To correct this condition, the cylinders must be washed with a lye solution at regular intervals to remove the sticky gum that is formed by the mixture of oil and dirt. Otherwise as heating develops, the volatile parts will be blown out and deposited in the brake equipment and in other air-operated devices and the residue will be burned, restricting parts and passages.

Locomotives with limited air capacity must have the air cylinders in good condition at all times. The heat developed is usually high which tends to vaporize the oil and blow it out of the cylinders. This necessitates increasing the amount of air cylinder lubrication which eventually is deposited in the air-operated devices with detrimental effect.

Lubrication

It is now recognized that continuous lubrication to both steam and air ends of compressors is essential to long life of the packing rings, reversing valves, bushings

* A report prepared for the Locomotive Maintenance Officers' Association.
† Assistant Superintendent, St. Louis-San Francisco.

and cylinder walls. There are on the market, lubricators which feed both steam and air ends as long as compressors are running. This principle is correct in that lubrication is continuous while the compressors are operating.

Trains operating through hilly country with many sags and curves to negotiate will use more air en route than is used at terminals. Under such conditions more oil should be fed to the steam end of compressors in route than while standing. In the absence of a force feed lubricator operated by the compressor, good results may be had by utilizing the locomotive mechanical lubricator to supply lubrication direct to the steam end of compressors while the locomotive is running. While standing, hydrostatic lubricator can be used to supply a lesser amount of oil through the governor to the steam cylinders. Our railroad has such an arrangement and the rules require that when compressors are started the hydrostatic lubricator is also started and set to feed one drop per minute as long as compressor is running. When the compressor is shut down, the feed from the hydrostatic lubricator is also shut off. When the locomotive is moving additional oil is supplied by the mechanical lubricator to the steam end of the compressor. The air ends of cross-compound compressors are lubricated with a light-grade oil. Single unit oil cups are used which feed this oil very sparingly to the air cylinders. Locomotives equipped with two 8½ in., 150 cu. ft. compressors and with above lubricating arrangement have been in continuous service for more than four years without renewing any rings in the steam or air end of the compressors. Applying force feed lubrication to the steam end of a duplex compressor has reduced the number of reversing valve ring renewals more than 50 per cent on locomotives so equipped.

Enginehouse Maintenance

A periodical check of discharge valves, particularly of compressors which are on locomotives with limited compressor capacity, proves beneficial, especially on such locomotives which do not have the filter type air strainers. Valves showing signs of dirt indicate that the air strainer is not functioning properly and the air cylinders need cleaning.

Flooding the steam end of the duplex compressors with valve oil during the orifice test will show up the worn reversing valve rings and bushings.

General Repairs

The shop facilities available for compressor repairs is indicative of the state of mind of those in charge of maintenance. To quote an authority who spoke on air brakes in general, "We should strive to develop a condition better than the minimum requirements if it is economically practicable. There are about as many different variations in the ways of doing brake repair operations as there are different railways. It is the quality of the finished product that counts. Any method of doing brake repairs, whether by machinery or by hand, does not amount to much if the quality of the results is not satisfactory. It is suggested you visit other railroad repair shops to learn whether the methods used by others are better or as good as your own. If you find by comparison a change of method is available, be broad-gauged enough to put the change into practice if authority is given." While the foregoing had to do with brake equipment in general, it is applicable to compressors.

It is not the intention to dwell here on certain machine operation tolerances over which there is no control other than to do it correctly, such as making press fits for bushings in steam heads. The 8½-in. compressor main valve bushings are received tapered from the manufacturer and require no machining. They are generally pressed home with a three-ton pressure. The steam chest bushings for the duplex compressors are usually pressed in with four to six tons pressure, depending on tolerances allowed. The bushing diameter is generally .003 in. larger than the bore when the casting is trued up and .005 in. larger if casting is not retrued.

Cleaning Vats

It is common practice on many roads when compressors are received at the shops for repairs to clean them thoroughly in a lye vat before they are dismantled. After cleaning and while suspended over the vat, the steam end is connected to a shop air line and compressor is operated to force all the solution out of the cylinders. Clear water is then circulated through the air end. The question of using or not using the lye vat will be decided by local conditions. Our road, having good compressor conditions, as outlined in the five points above, found it unnecessary to put compressors in the cleaning vat for interior cleaning. Hence the use of lye vats for assembled compressors has been stopped. After this change in practice it was noted that no more drilled steam ports in steam heads were found restricted or plugged shut. From this it is assumed the plugging of drilled ports, such as were found occasionally, occurred in the lye vat.

Inspection Bench

Some railroads do not dismantle compressors until the lugs and cylinders are coated with whiting to detect cracks. The compressed air is admitted to the cylinders (discharge and exhaust ports plugged) to detect porosity and leakage at stuffing boxes and centerpiece gaskets. After the heads and piston rods are removed, the gaskets between the cylinders and centerpiece are tested by capping the stuffing boxes of the high pressure cylinders and closing the high pressure cylinder with a plate. Air pressure is then admitted through the high pressure cylinders and soap suds are applied to the gasket edge in the low pressure cylinders to detect leakage. This method makes it unnecessary to separate the steam and air cylinders from the centerpiece to inspect the gasket.

Air and Steam Cylinders

The cylinders are usually "miked" to determine whether they are worn enough to require grinding or reboring. Both of these methods have adherents. Those who rebore cylinders will generally admit that nothing is done to the cylinders unless there is a difference of at least $\frac{1}{32}$ in. between the smallest and largest diameters. This means that the piston clearance in the large part of the bore is apt to be at times $\frac{1}{16}$ in. or more, where $\frac{1}{32}$-in. piston diameter clearance in cylinders is permitted.

On our road, cylinders are ground on a Micro grinder. The alignment of steam and air cylinders is reasonably close so that pistons may be fitted to cylinders with .007-in. to .010-in. without binding. It is the opinion of those in charge of this work that close fitting pistons, particularly in the high pressure air cylinders, are a great help to worn packing rings in holding lubrication should abnormal or unfair usage cause compressor heating. Casting dates on cylinders indicate that more than 25 years' service is obtained before they are ground to the maximum allowable diameter.

Steam Heads

Ring grooves in the main piston valves when worn .002 in. are trued for the next ring size which is .006 in. thicker than standard. In fitting rings to the main piston valve the clearance in the groove is held to .0015 in. Main piston valve bushings are renewed when worn .010 in. Some

roads allow more tolerance, but it is felt that to prevent steam blows and not carry oversize parts is more economical. The same method of close tolerances is followed with reversing valve piston and bushing. More than four years' service is common without renewing rings and it is expected these bushings will give at least eight years' service. This is attributed to the good lubrication, preventing slight rusting each time water accumulates when compressors are shut down. The slide valve type reversing valve also gives long service and failures of the reversing rod are unknown. This may be due to the good lubrication and the fact that reversing valve rods failing to pass gauge tolerances are scrapped. When the depth of the exhaust cavity in the reversing slide valve becomes less than $\frac{7}{32}$ in., the valve is scrapped. The clearance of the reversing slide valve in its bushing seldom exceeds .030 in. with minimum of .005 in. The facing of reversing valve caps is seldom necessary. When this is done, allowance is made for end clearance of reversing valve rod.

Air and Steam Pistons and Rods

Steam pistons and rods are condemned when the rod is ground $\frac{1}{16}$ in. under standard. Piston heads worn out-of-round are cut down for use in cylinders of smaller diameter. This is possible by purchasing the largest oversized diameter pistons. Condemned low pressure air pistons are cut down for use in high pressure air cylinders. Ring grooves worn more than .003 in. are recut for the next over-sized thickness ring. In fitting rings to the air and steam piston a clearance of .002 in. to .003 in. is maintained. Lap joint rings only are used in air and steam pistons. The piston rods are trued on a grinder at each general overhauling and held true to .001 in. Metallic piston rod packing is used.

Air Valves and Seats

Considerable care is given to air valves and seats, the tolerance for the wing fit in seats and cages is held to not less than .005 in. or more than .020 in. The lift for the 8½-in. compressor is $\frac{3}{32}$ in. and for the duplex compressor is $\frac{5}{32}$ in. Air valves with ball seats are used which insures true seating. The width of the seat is held to $\frac{1}{8}$ in.

Placing responsibility where it belongs after careful and reliable investigations of compressor failures has done more to promote good compressor conditions than could have been obtained in any other way. One of the best corrective measures has been the provision of ample compressor capacity.

Shop practice conducive to good maintenance may be summarized as follows:

1—Air compressors should be given a general overhauling at shops having facilities for doing the work.

2—A record of the repairs should be kept in book form.

3—A serial number should be given each compressor.

4—A special jig should be used when removing piston rod nuts and

5—When pulling air heads from piston rods a special puller must be used. Do not use a sledge hammer for this work.

6—When stripping pumps, care must be taken not to damage the reversing rod or valve. Special care should be taken with pistons as the rod and ring groove can easily be damaged.

7—After air compressors have been overhauled they should be placed on a test rack and pass prescribed tests;

8—When cylinders are ground, care must be taken to see that all four lugs are in line to make a bearing. A special gauge is used to check the alignment.

9—When fitting pistons to cylinders, the following tolerances should be followed: Pistons up to 10 in. diameter to be turned .001 in. per inch diameter smaller than cylinders; on pistons over 10 in. diameter, turn .010 in. smaller in diameter.

10—Ring grooves should never be filed.

11—Piston rods should be ground at each overhauling and condemned when $\frac{1}{16}$ in. smaller than standard diameter.

12—Duplex air compressor piston heads that do not require pulling down on rod before touching shoulder should be renewed.

13—All piston rods should be kept standard length and taper fit should not be machined.

14—Final fitting of piston heads and rods should be checked for length and no clearance allowed.

15—All heads should be line-in-line with cylinder faces.

16—Examine tappet plates on steam piston heads to see if they are loose or if the reversing rod hole is worn. If loose renew bolts; if worn, renew plate.

Dimensions Between Heads and Draw on Pistons

Kind of compressor	Draw, in.	Standard dimension between heads, in.	Minimum dimension between heads, in.
No. 2 duplex	$\frac{3}{64}$	$16\frac{5}{16}$	$16\frac{9}{32}$
No. 6 duplex	$\frac{1}{32}$	$18\frac{23}{32}$	$18\frac{1}{16}$
No. 5 duplex	$\frac{1}{32}$	$21\frac{11}{32}$	$21\frac{5}{16}$
9½-in. single stage..	$\frac{3}{64}$	$18\frac{21}{16}$	$18\frac{43}{64}$
8½-in. cross-compound	$\frac{1}{32}$	$22\frac{11}{16}$	$22\frac{43}{64}$

Standard gauges must be used on all pistons before they are applied to cylinders.

17—All cylinders to be ground—trued up only. When cylinders are ground to ¼ in. larger than standard the cylinder walls should be checked for thickness to determine whether further grinding is permissible.

18—Cylinders must be mounted on center piece and set up on Micro grinder in pairs before grinding. No grinding of single cylinders permitted.

19—When grinding cylinders the counterbore must be maintained standard. Stuffing boxes must be cleaned up to assure alignment.

20—Examine stuffing boxes to see if they are loose or threads are in poor condition. If so, remove dowel pin and tighten, relocating dowel in a new spot.

21—Low pressure steam cylinders on 8½ in. cross-compound pumps must have by-pass ports in each end of the cylinder maintained to standard dimensions, which are as follows: Length 2 in., width $\frac{5}{8}$ in., and depth $\frac{3}{16}$ in.

22—When new stuffing boxes are applied, the rod fit portion shall be $\frac{1}{32}$ in. larger than rod and condemned when $\frac{1}{16}$ in. larger than rod. Stuffing box gland shall be a sliding fit on the rod and $\frac{1}{32}$ in. smaller than the stuffing box. Stuffing boxes and stuffing box nuts having defective threads or lugs must be removed.

23—Air valve gauges should be a good fit in the threads. The seat should not exceed $\frac{1}{8}$ in. in width.

24—A standard lift gauge should be used on all valves. The air valves for the No. 2 duplex compressor should have a lift of $\frac{1}{16}$ in., the No. 5 and 6 duplex $\frac{5}{32}$ in., and the 8½ in. CC, 9½ in. and 11-in. SS $\frac{3}{32}$ in. lift.

25—Adjust lift on air valves by reducing the boss on the valve and not machining the stop in chamber, cap or cylinder.

26—New air valves should be applied when wings on valve become .020 in. smaller than bore in seat. Minimum wing clearance should not be less than .005 in. lock to prevent seat from working loose.

27—Threads on valve seat, valve cages cap screws and caps should be coated with graphite and oil before being screwed into place.

28—Special reamers should be used on upper valve seats instead of removing seats. Remove seats only when worn too low to make a standard wing valve.

29—Rings should be a "hand-turning" in the piston grooves.

30—Rings should be condemned when their width is .005 in. smaller than the ring groove.

31—When ring grooves are worn .002 in. to .003 in. the grooves should be trued .006 in., 0.12 in. or .018 in., oversize widths for oversize rings furnished for retruing.

32—A file should never be used on the sides of the ring or in the ring groove.

33—Care should be taken to be sure that the rings used are the same diameter as the cylinder.

34—Rings must not be hammered or "set out" as they are a perfect circle.

35—Lap joint rings only are to be used except where angle-cut rings are the only type made for the particular piston in which they are to be used.

36—Rings to be fitted to walls of cylinders with .003 in. end clearance.

37—Duplex compressor head bushings (steam) to be renewed when worn .015 in.

38—Careful inspection to be given threads in steam head connections.

39—Reversing valve bushing caps (where gaskets are not used) to be ground in.

40—Use standard gauge on reversing valve rods for wear. Examine shoulder on rod and button on end of rod. Rods failing to pass the standard gauge are scrapped.

41—With cross-compound compressors, the large main valve bushing and small cover bushing to be renewed if worn .015 in. larger than standard. When new bushings are applied or when they have a shoulder but are worn to the condemning limit, they are to be trued with a reamer equipped with guides to insure perfect alignment. The head of the piston valve bolt to be maintained 9/16 in. deep.

42—Reversing valves to be scrapped when distance between rod groove and seat is 1/8 in. less than standard. The combined wear of the reversing valve face and its bushing seat should not exceed 1/8 in. If so, use next repair size valve.

43—Reversing valve bushings seats to be faced. Renew bushing if distance from the slide valve seat (8½ in. CC) to the top bushing exceeds 1 39/64 in.

44—Reversing valve rod bushing to be renewed when .008 in. loose on a new rod.

45—Reversing valve (8½-in. CC slide) to be renewed when exhaust cavity is less than 7/32 in. deep.

46—When applying heads to cylinders, tighten the nuts around the ports first and then the outer nuts around the flanges. All nuts should be re-tightened when compressor is on test rack and very hot.

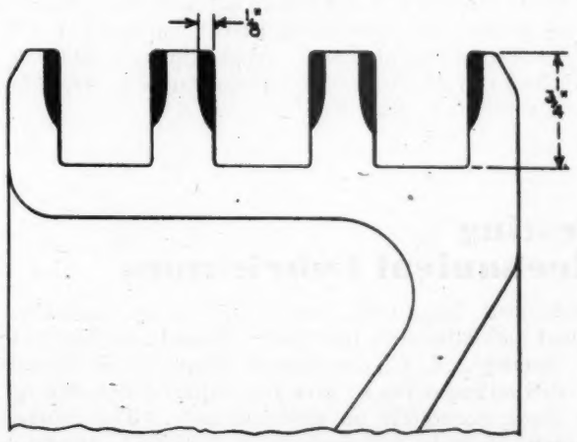
Flame Hardening Piston Head Ring Grooves

By Stephen Smith*

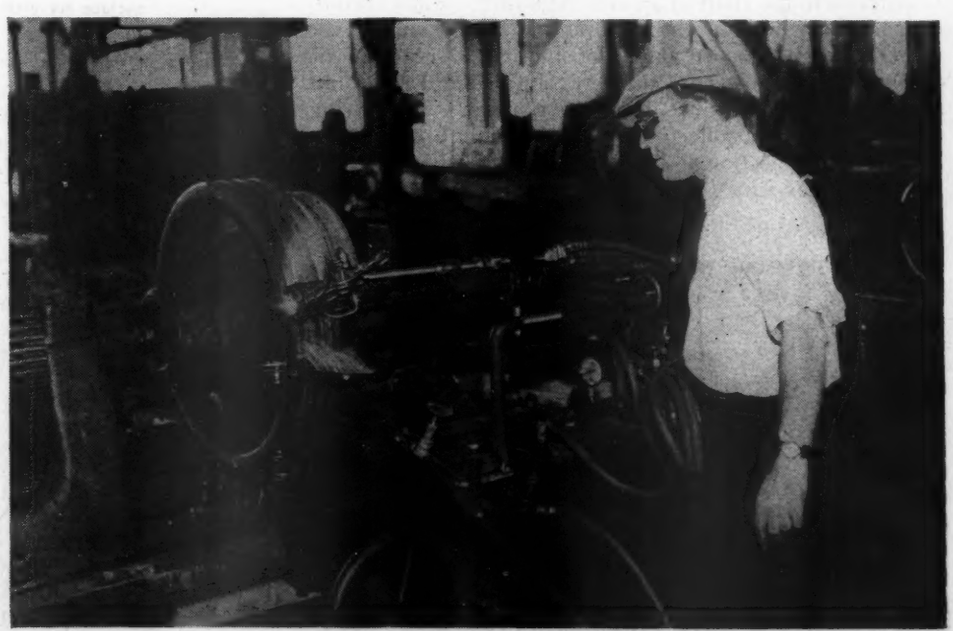
Railroads throughout the country are showing increasing interest in the application of oxyacetylene flame hardening on railroad equipment that is subjected to constant wear and requires frequent repairs. One of the principal locomotive parts which is subjected to severe service is the piston head. The head, during its motion in a locomotive cylinder undergoes a reciprocating action which forces the piston rings alternately to one side of the piston ring groove and then to the other. The alternating pressures thus exerted by the piston rings against the walls of the ring grooves, in conjunction with other forces, gradually wear down the walls. As the amount of wear increases, the rate of wear also increases, with the result that it finally becomes so great as to seriously reduce the efficiency of the piston and repair or replacement of the piston head becomes necessary.

To reduce this wear and prolong the life of steel piston heads, a number of railroads are now flame-hardening the walls of the piston ring grooves, or specifying that they be flame-hardened by the manufacturer. This operation is quite simple and can be performed with a minimum of equipment and set-up time, following procedures which have become standard in flame-hardening practice.

As the ring groove wear takes place gradually from the top of the groove wall downward, it is necessary to flame-harden only the top portion of the walls to overcome the rapid wear. Therefore the walls are flame-hardened for a distance of ½ to ¾ in. downward from the top of the piston head. The piston head is mounted on a piston rod and the whole assembly is placed between centers on a lathe. The lathe is geared to rotate the head at a constant speed for progressive hardening. This speed will



Cross-section of piston head showing areas to be flame hardened and the depth of penetration on the walls of the ring grooves



Locomotive piston ring grooves are flame hardened on a lathe using a multiflame torch tip to harden the walls of all grooves in one operation

* Applied Engineering Department, Air Reduction Sales Co., New York.

vary with the size of the head and grooves to be flame hardened. The piston head shown in the illustration was 26 in. in diameter and the speed of hardening was 6½ circumferential in. per min. It is recommended that a variable speed over a range of 4 to 8 in. per min. be provided so that heat and speed can be adjusted and coordinated properly to give the desired depth of hardness.

Hardening is done by a special torch which consists of three separate multiflame tips and quenching jets, each of which fits into one of the grooves and heats and quenches both walls simultaneously. The six walls are thus treated in a single operation. The three-part tip is held by a torch-adjusting arm mounted on the lathe carriage. This arm is needed to permit the fine adjustments necessary to position the tip in the ring grooves.

In addition to the quenching jets incorporated in the tip, an auxiliary cooling quench is set up below the tip to take care of any residual heat in the piston.

The walls of all the grooves are flame-hardened by the progressive method in one revolution of the piston head. The head shown was hardened in 12 min. The surface hardness secured will depend on the analysis of the metal in the piston, but generally a Brinell hardness of 450 to 550 is desired and obtained. Approximately 30 cu. ft. of acetylene and 33 cu. ft. of oxygen are used in flame hardening each 26 in. dia. head.

Testing Mechanical Lubricators

Mechanical lubricators are tested on a specially-designed rack after they have been cleaned and repaired at the Spencer, N. C., locomotive shop of the Southern. Needed adjustments to give the required delivery of oil are made accurately on this test rack. The lubricator pump is driven by rod connections which are adjustable to reflect accurately the various wheel diameters of locomotives. This adjustment is obtained on a wheel which is fastened to the shaft of an electric motor. Each revolution of the wheel on the test rack is equivalent to one wheel revolution on an actual locomotive. An automatic counter is used to record these revolutions and the count is readily converted into "locomotive miles." Measuring cups are used to collect the oil delivered through each lubricator connection. This oil delivery when checked against "miles run" and known lubrication requirements determines whether any or all of the lubricator connections need adjustment to increase or decrease the rate of oil flow.

This test rack is calibrated to give lubricator oil-delivery readings which reflect actual service operating conditions

Locomotive Boiler Questions and Answers

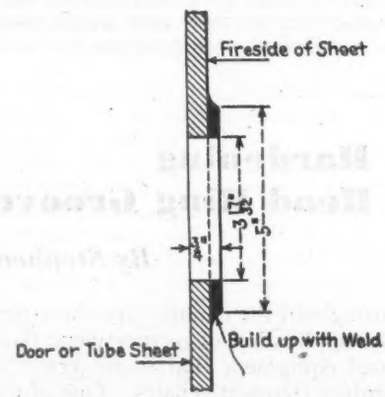
By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Reinforcing Liner At Arch-Tube Hole

Q.—I have observed several locomotive boilers which have a reinforcing liner riveted to the firebox tube sheet around the arch-tube hole. Why is this liner necessary on a stayed surface?—F.I.K.

A.—A liner around the arch-tube hole in the firebox tube sheet is not used as a reinforcement when the tube hole is in a stayed area. The liner is generally applied to provide additional bearing surface for the tube. Some railroads obtain the same results by building up around the arch-tube holes by welding as shown in the drawing.



Welding may be employed to give additional bearing surface for arch tubes at the sheet holes

A Correction

Q.—In the August issue of the *Railway Mechanical Engineer* you show, on pages 371 to 373, inclusive, the method of calculating the efficiency of a sawtooth boiler seam. In the numerator of formula No. 4 the last letter shown is *A*, which probably is a typographical error, and I assume it should be *S*. Formula 10 gives a denominator "P x TS x t". However, in the solution you show *L* plus 1 or 15.52 as the first number. When using this number (15.52) in the solution a different result is obtained from the one shown. The answer you give is evidently derived by using 14.42 in the division. In view of the importance of this formula, I would like to be informed as to just what the correct letters and figures are for formula No. 10.—J. H. Y.

A.—The last letter of formula No. 4 should have been *S* instead of *A* as shown. Formula No. 10 should have read as follows:

$$(10)\quad E = \frac{L\text{-}4D \times TS \times t}{L \times TS \times t} \times K$$

substituting in the formula:

$$(10)\quad E = \frac{(14.52\text{-}4.625) \times 55{,}000 \times 0.75}{14.52 \times 55{,}000 \times 0.75} \times 1.401 = 95.4$$

Welding Repair to Engine-Truck Casting

*By R. C. Hempstead**

The leading truck bed of one of our modern locomotives was so badly damaged in an accident that normally it would have been considered totally demolished. This truck bed was restored to service by employing arc welding and oxyacetylene flame processes to avoid the delay which would have been necessary to obtain a new casting.

Flame straightening, machine gas cutting and welding were all used in repairing this damaged engine-truck casting

Photos Courtesy Air Reduction Sales Co.

The repairs involved straightening of distorted areas by oxyacetylene flame heating, gouging and welding broken pieces of casting, and building whole sections made of flame-cut and welded plate to replace sections lost in the accident.

The broken casting with three pedestals and parts

Three pedestals and a part of the body of this truck casting were broken off in an accident

of the main structure missing, is shown before straightening. Two multi-flame heating torches were used for straightening, consuming about 900 cu. ft. each of oxygen and acetylene. After straightening, flame gouging torches were employed to gouge out grooves and vees on the broken edges in preparation for welding.

At the same time, replacement sections were fabricated by welding for attachment to the casting. These parts were cut from rolled steel plate of appropriate thicknesses, and shaped by a gas-cutting machine to fit the broken edges of the casting. After welding of the cut parts, the fabricated portions were then welded to the main casting to complete the reconstruction job.

Chalk lines on the repaired truck indicate where some of the welds were made. While a material saving in excess of $900.00 was realized, the important factor involved was the restoration of the locomotive to service in a period of three weeks. Eight or ten months would have been required to obtain a new casting. It is impossible to calculate the over-all savings. The reconstructed truck has been in service for approximately 120,000 miles and is functioning as well as the original casting.

* * *

Boiler backhead and other cab work is done at the Spencer, N. C., shop of the Southern from all-welded working platforms built to locomotive deck height. They are easily moved with a sling which is attached to overhead traveling cranes

* Assistant superintendent of motive power, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.

With the Car Foremen and Inspectors

Use of Standard Practices in Servicing and Maintaining Air Brake Equipment*

By C. D. Stewart†

Care in threading, bending and applying piping needed—Clean parts essential—Lubrication requirements simple with good standard lubricants available

We are designers and manufacturers of air brakes, and you as maintainers, have the same single object in mind, that of improving the brake operation of American railroads. I fully realize that you men are better acquainted than I with the so-called "tricks of the trade" that have to do with the manner in which repair track work is done efficiently. But I thought it would be helpful to discuss some of the reasons why we carefully selected the materials that we did, and why we have included certain new features in the designing of some of the details, because it is always easier to do a better job if you know why you are asked to do it in a particular way.

There are a number of features that could be covered in this manner, but I have limited the number to three, with the idea in mind that a few thoroughly discussed and remembered will be more worthwhile than many touched upon briefly and forgotten. For the first of these three I have selected the pipe fittings that have been designed for the special purpose of maintaining rigid leak-proof piping on the cars. We did not always provide this desirable feature. Prior to the designing of the AB freight brake and HSC passenger brake equipment the pipe connections were made with conventional pipe taps in the valves, brake cylinders and reservoirs. The angle cock was the only exception in that it was provided with an extension for use of a U-bolt clamp that secured it firmly in place. Vibration and lateral movement of the adjacent pipe was thereby prevented. For many years pipe breakage was entirely too commonplace and brake pipe leakage was considered inevitable. In the design of the quick service feature of the K triple valve, material brake pipe leakage was relied upon to produce part of the local brake pipe reduction. This seems strange today when brake pipe leakage in excess of two pounds per minute is considered an unnecessary waste of air. All-wood car construction was common in those days and the weaving of the underframe made it impossible to keep pipe joints tight. When steel underframe cars became common, brake pipe leakage could be controlled, and many of you, no doubt, have seen long trains of K equipment with brake pipe leakage so low that the rear-car brakes would not apply with a substantial service reduction. The universal use of steel underframe cars gives assurance of a reasonably unyielding support for the car piping. If proper attention is paid, therefore to the means for preventing vibration or lateral movement of the piping from train-slack shocks, the joints will remain airtight indefinitely and pipe breakage will not occur.

With the assurance of brake pipe integrity the AB quick service feature was designed to function at its best without the aid of brake pipe leakage. Furthermore, it is obvious that other functions of the equipment benefit from less leakage. Among these is the release of the brakes following either a service or an emergency application, it being more prompt and more reliable. The saving in air is also a material benefit, both in reduced cost of compressor operation and maintenance. These factors are of such importance that much thought was given to the design of a better means for clamping the piping; first, to prevent movement under conditions of severe shock as often occurs during humping, and, second, to prevent vibration that can occur at high speed. Examination was made of a large number of pipe failures and it was surprising to find that most of them occurred in piping that was clamped in an apparently substantial manner with conventional pipe clamps. These findings suggested the need for supplementary clamping means associated directly with the devices to which the piping is attached.

You are all familiar with the clamping extension on the angle cock that was developed some time prior to the designing of the AB equipment. This clamping means has been very successful in protecting the two ends of the brake pipe from damage. The mid-car portion of the brake pipe, however, still suffered frequent damage. Obviously, a clamping means applied to the branch pipe tee fitting would provide an anchor support comparable to that on the angle cocks. This clamping, however, can not be as simple as that for the angle cock because of the branch pipe leading off at right angles to the brake pipe and it is not possible to always cut the branch pipe to the exact length. The car bracket, therefore, must have a bolting *slot* instead of a *hole* to allow for adjustment. When installing the pipe the tee fitting is held in place by the bolt fastened only finger tight until

* A paper read before the Eastern Car Foreman's Association in New York on November 10.

† Director of engineering, Westinghouse Air Brake Company, Wilmerding, Pa.

the piping is completed then the clamping nut is drawn up tightly, thereby fastening the pipe securely and without strain. Various types of cars require various modifications of this bracket, which are illustrated in the manufacturers pamphlet No. 2518, entitled, "Installation Specifications." Incidentally, this pamphlet has recently been designated an A. A. R. pamphlet, making the sixth brake pamphlet to be so designated. The others are the test codes for the K and AB valves, the maintenance codes, and the single car testing code.

For the purpose of removing any strain that may be in the piping, we have also provided special pipe fittings associated with this branch pipe tee as well as the AB pipe bracket, brake cylinder, auxiliary and emergency reservoirs, and the retaining valve pipe bracket.

Installation of Piping

In order that the reinforced pipe fittings may perform their intended function, it is necessary that the piping associated therewith be properly prepared and installed. There is, therefore, a joint responsibility between the manufacturers of these fittings and the users. There are two practices on the part of the users that can materially offset the benefits of the improved pipe fittings. First, the pipe threading can be done improperly. It is surprisingly common to find pipe threads cut eccentrically. This unquestionably is done through neglecting to use the guide bushing in the die stock. It is obvious that if the thread is cut eccentrically, the pipe will be located in the reinforced fitting eccentrically and, when the concentric clamping ring is tightened, the pipe threading will be placed under a heavy strain and may actually fail immediately. As a matter of fact, it is not uncommon to find pipes broken in the threading before the cars have ever turned a wheel.

Second, the pipe can be lined up improperly with respect to the bolting face of any of the air brake devices. This may be due either to the pipe being of improper length or, if it is a curved pipe, to its not being bent accurately. Under no condition should the pipe be sprung into place. If it is of improper length it should be changed, and if it is not of the proper shape, heat should be applied and, with one end secured in place, the other end should be moved, without strain, into its proper position. Pipes put up under strain are very likely to break in service.

The practices to be followed in order that you may realize the full benefit of these improved pipe fittings are so relatively simple that it is surprising to find the extent of improper practices. To realize how widespread are troubles from broken pipe, one need only study the docket of the A. A. R. Brake Committee under the heading of "Broken Pipes and Pipe Clamps." This docket has been active for a number of years and the little progress made in improving the situation is very discouraging. You gentlemen could make a splendid contribution to this important matter if you could advise the brake committee that everyone of your members follows the recommended practices with respect to the installation of piping on passenger as well as freight cars.

Keeping Parts Clean

The second of these three features to be discussed has to do with the advantages of keeping all of the operating parts clean. So much has been said about improvement in train operation that has resulted from the use of the AB brake that we lose sight of the great improvement in reduced maintenance made possible to a large degree by the exclusion of dirt. The valve portions and the brake cylinder have been provided with filters so that all air entering these devices during their normal operation is thoroughly cleaned. As a result of this the lubricants remain fresh and clean and the moving parts are not worn by the abrasive action of dirt.

The entrance of dirt into the air brake equipments of previous designs was a very large contributing factor in establishing the relatively short cleaning period and was responsible for the shortened life of the devices. There is a short period of time, however, when the parts are being moved from the repair shop to the repair track when the valve portions and the brake cylinder pistons are not protected by filters. Therefore, to insure that no dirt enters these parts during this time, special care should be taken to protect them adequately. The valve portion should be so handled that no dirt whatsoever can get into the valve structure.

The manufacturers have provided shipping covers that seal the bolting faces, but there are some additional small openings into the valves. One medium-sized western road has built metal boxes with dust-tight covers held closed by a hasp for shipping valve portions of all types from the repair shop to the place of installation. At other places repaired valves are stored out in the open with no protection at all from the weather. It is obvious that the elaborate strainer protection means provided on the brake cylinder and the valve portions cannot protect the device from dirt that is permitted to enter while the parts are disassembled.

Just before the valve portions are applied to the pipe bracket, all loose dirt should be thoroughly blown from the bracket and its surroundings in order that no loose particles can fall into the piston bushings as the portions are mounted on the cars. For those of you who make a practice of servicing the brake cylinder piston in a repair shop the cleaned and greased piston should be placed in a clean, dust-tight container for transporting from the repair shop to the car track. Precautions should also be taken to insure that no loose dirt falls on to the piston as it is entered into the brake cylinder.

Lubrication

The third point deals with the lubrication of the parts. We will talk first about the brake-cylinder lubricant. As you know, the A. A. R. have recommended a new type of brake-cylinder lubricant and have assigned specification No. M-914-42 to it, and made reference to it in several of their maintenance publications. The manner in which this new lubricant came into use will be of interest as it will serve to show why a lubricant of this character is employed by the manufacturers and recommended by the A. A. R. for subsequent use.

Grease is a compound of substantially 85 per cent oil and 15 per cent binder. The chemists refer to the latter as soap, and it has few or no lubricating qualities. It serves, therefore, only to hold the lubricant in position, particularly where gravity would tend to draw it away. It will be apparent that this is particularly true on the top and side walls of a horizontally mounted cylinder. Almost any grease will perform satisfactorily if the variations in temperature to which it is subjected are not materially large and if the service period does not extend beyond a year. Brake equipment, however, is subjected to temperatures as low as 40 deg. F. below and 140 deg. F. above zero, and the service period for modern brake equipment is 36 months.

Greases not properly compounded develop several shortcomings under these conditions. At sub-zero temperature they harden; at high temperatures the oil sweats

out of the soap binder, particularly if the time is extensive. The oil thus liberated will gravitate to the bottom of the brake cylinder, leaving the non-lubricating soap adhering to the top and side walls. Because of the non-lubricating quality of the soap, the packing cup wear at the top side is accelerated. On the other hand, the free oil in the bottom of the cylinder tends to soften that portion of the cup and it ages prematurely. Because the sweating out of the oil is a slow process, the 15-month cleaning period, standard with the K equipment, brought about renewal of the brake-cylinder lubricant in sufficient time to avoid material deterioration of the lubricant. The three-year cleaning period, however, of the AB equipment, particularly when it is mounted on hopper cars where the sun can heat the brake cylinder above the surrounding temperature, would find a material amount of free oil in the bottom of the brake cylinders after several months service.

Having these facts in mind, we prepared a performance specification for brake cylinder lubricant, and invited all manufacturers of this type of lubricant to submit samples for laboratory tests. The response was most gratifying, but the problem proved to be a most difficult one. Many months passed before any samples were ready for test, and although the first ones showed much promise they nevertheless fell very far short of the goal that we had in mind.

After many additional months a grease was finally developed that gave indications of meeting all the requirements. Many test brake cylinders were assembled and placed in operation under varying conditions. Some were placed in our cold room and operated at minus 40 deg. F. Some were placed in our hot room and operated at 140 deg. F. Others were operated in the open air. A like number of cylinders were lubricated with a former grease and operated under similar conditions. After approximately one year of satisfactory operation the new grease was considered safe for road trial and a large number of brake cylinders were installed on cars under the joint observation of the brake manufacturers and the A. A. R. Brake Committee.

The result of all these tests was that after three years in the laboratory and in actual revenue service, the grease was found to provide perfect lubrication for at least a three-year period and under the extremes of temperature found in service. A manufacturing specification was then prepared by our laboratory covering the grease as tested and some months later, at the request of the A. A. R., we turned over to them this specification. They assigned their own number to it and show it in their various manuals and instruction leaflets as recommended for practice. Several manufacturers have submitted greases that meet this specification so that it is available from a number of sources. In spite of this, a number of roads have not yet standardized on this grease. The brake manufacturers sole interest in this improved lubricant is that when the railroad repair shops recondition their equipment they are as suitable for 36-months of satisfactory service as they were when purchased new.

We have heard from several railroaders two criticisms of this lubricant. One is that the specification is unnecessarily severe. We have had no difficulty in obtaining grease that meets these specifications and it seems unnecessary, therefore, to modify them to make them less exacting. The other criticism is that the grease is more difficult to apply in brake cylinders than the former grease, particularly during the sub-zero weather. This is a fact but the benefits resulting from its use are so marked that many users are entirely willing to put up with this slight inconvenience. As a matter of fact some of the users have devised ways of overcoming this difficulty during very cold weather. I am sure, therefore, that you will agree that if there is a real desire on the part of the users to obtain a lubricant that will improve the life of the brake cylinder packing cup and at the same time have it more efficient during this life, that it will not be particularly difficult to devise ways for more easily applying it during cold weather.

Triple valve lubricant is perhaps even more important, and there is no problem associated with its use as compared with any other form of valve lubricant. Again, as with the brake-cylinder lubricant, the long service period is what makes the use of the proper oil for the triple valve of such vital importance. The chief requirement in a lubricating oil is that it remain of the same consistency or viscosity over the entire period of its use, which in the case of the AB service and emergency portions is for a period of 36 months. With exceedingly few exceptions all lubricating oils tend to get gummy as they age. The chemists refer to this phenomenon as oxidation. What actually happens is that most lubricating oils contain some compounds that combine with oxygen from the air to form new compounds of higher viscosity. To avoid this undesirable reaction, the oil is refined under special conditions to remove those ingredients that have an affinity for oxygen.

About the time the AB brake was being designed, a vastly improved method of refining lubricating oil was likewise being developed and it was found that this new oil would not oxidize over a many years period. Therefore, it remains of the same viscosity indefinitely. This oil is used by the brake manufacturers exclusively and, again at the request of the A. A. R., we furnished them with a specification to which they have added their own serial number, namely M-912-41. There is such a small amount of this oil used per device that the cost is a negligible item and it is surprising, therefore, to find that some roads still make use of oils that do oxidize during the regular cleaning period.

If the proper oil is used in the self-oiler piston and some portion of it is still in the oil reservoir in the piston head at the end of the three-year period, it is entirely satisfactory for continued use. Therefore, new oil that is required to fill this reservoir can safely be added to the old oil that remains. On the other hand, if on examining the piston it is found that improper oil has been used and as a consequence it shows evidence of gumminess, the piston and the capillary wick which feeds the oil from the oil chamber to the ring groove should be thoroughly cleaned with an approved mineral solvent.

If you men feel as I do that the features discussed here this evening are of great importance in insuring long periods of trouble free brake operation, then I strongly recommend that steps be taken by your organization to see that these practices be faithfully followed in every repair yard under your jurisdiction. Not only will you benefit directly by this action here at home, but you will benefit indirectly through the example you set up here spreading to other repair centers throughout the country.

EDWARD G. BUDD, president of the Edward G. Budd Manufacturing Company, Philadelphia, Pa., "because of his outstanding engineering achievements" was awarded the A.S.M.E. Medal at the recent annual meeting of the society held at New York. Among the developments cited are the all-steel automobile body; the steel-disk automobile wheel; the Shotweld process for use in passenger train-car and other structures, and lightweight passenger trains.

Questions and Answers On Welding Practices

Polarity In Welding Currents

Q.—Will you explain reversed polarity in welding?—E. K.

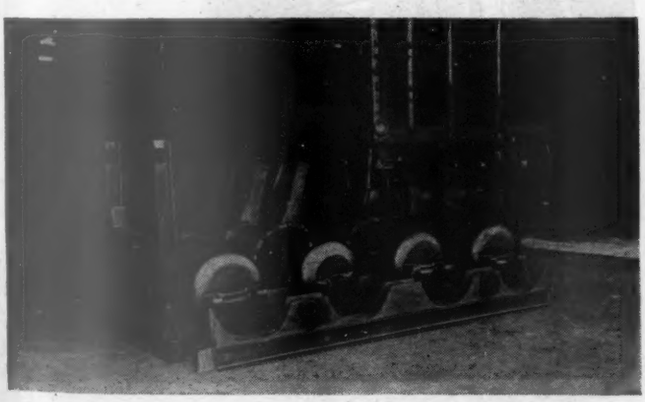
A.—The polarity of a welding current is either "straight" or "reversed". With straight polarity the electrode is negative and the work positive; with reversed polarity the electrode is positive and the work negative. Straight polarity is used in welding with bare or lightly coated electrodes due to the fact that somewhat more heat is generated on the positive side of the circuit with such electrodes. However, the addition of a coating to the electrode forms gases in the arc and the presence of these gases may alter the heat conditions so that the opposite is true; the greater heat being produced on the negative side. Also, heat conditions are affected differently by different types of coatings. One type may provide the most desirable heat balance with straight polarity while another on an electrode of the same metallic qualities may provide a more desirable heat balance with reverse polarity.

The polarity to be used with a particular electrode is established by the electrode designer. When doubt exists as to the correct polarity, the turn-off rate of the electrode will serve as a good guide. Each polarity is used to burn off 6 in. or 8 in. of electrode. The polarity which results in the longer burn-off time is generally the one which produces greater heat in the plate or joint. This is desirable in some cases while in others it is desirable to use the polarity which produces less heat in the plate.

The above refers only to welding with direct current. With alternating current, since polarity changes very rapidly, the electrode must be suitable for use with either polarity. This does not mean, however, that a straight or reversed polarity electrode will not be satisfactory with alternating current. As a matter of fact, shielded arc electrodes of high quality will provide satisfactory results on alternating current, even though it is designed for use with direct current.

Carrier for AB Reservoirs

The Reading Company has been carrying on an extensive new car building program at its Reading, Pa., shops for several years which has involved the handling of thousands of AB cylinders along the construction tracks. The carrier shown in the illustrations was developed to facilitate cylinder handling between the storage area and the working locations. It fits on the platform of a shop truck which is pulled from the storage location into the shop by a tractor after it has been loaded. Holes in the carrier corner posts for crane-sling hooks are used when removing it from the truck and an overhead crane carries the entire load safely to the air-brake spot on the construction track. The rack has a capacity of eight reservoirs, four on the bottom and four on removable rails which fit over the bottom row.



Removable rails serve as holders for the top tier of cylinders

The cylinder carrier is removed from the shop truck by means of an overhead crane

Southern Paint Track Facilities

Painting forces at the Chattanooga, Tenn., car shop on the Southern use a wheeled cart which runs on a narrow gauge track when working the two long paint tracks which are located at that point. These tracks have a capacity of forty cars and the service tracks extend the full length of both, the cart passing from one track to the other through a switch located at the track ends. The cart which has a capacity of 80 gallons of red and 40 gallons of black freight car paint, is built of an old locomotive air reservoir which is mounted on section

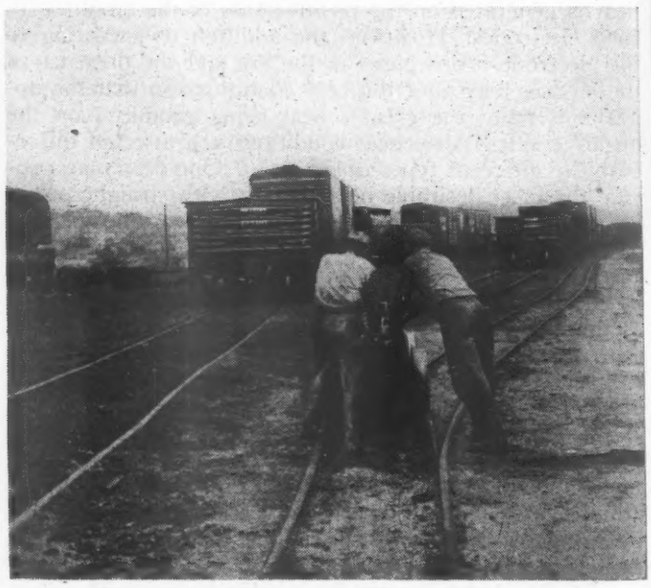
Cars are brush-stencilled

The service cart has reservoirs for black and red freight car paints

car wheels. The reservoir was cut in half and reassembled with a dividing plate welded between the halves to provide the two sections for red and black paint. Each section is equipped with fittings for the attachment of an air line, the outlet hose to the spray gun and a bleed valve to relieve pressure in the tanks. In addition there is a large filling port in each of the sections fitted with a screw-type cap. Enough paint hose is carried on each end of the cart, one attached to the black tank, the other to the red, to permit the complete painting of two cars without moving the cart.

Stock supplies of paint are kept in a filling station located about midway of the paint tracks. This consists of two large tanks equipped with motor-driven agitators, one tank for red the other for black paint. Paint is received ready-mixed in 55-gal. drums which are raised by an electrically-operated chain hoist for dumping into the storage vats. As the reservoirs in the paint cart require refilling, the cart is run up to the storage location and filled through valve-operated outlets.

It is the practice to paint the cars on one track while stencilling of already-painted cars proceeds on the other. The open space between the two paint tracks is sufficiently wide that no difficulty is experienced with sprayed paint being blown upon freshly-stencilled cars. Of most importance in this arrangement for painting and stencilling is the fact that, once the cars are spotted on either paint track, they do not require shifting until they are ready to be pulled from the track and placed on the ready track for dispatchment.



Service cart passing through switch which connects the two paint tracks

Filling station for the paint-track service cart

Complete sets of restored brush rigging, field coils and pole pieces are kept in baskets ready for assembly

Progressive Motor Maintenance

Rock Island methods allow for orderly procedure in which a complete record is kept of all work done

Part II

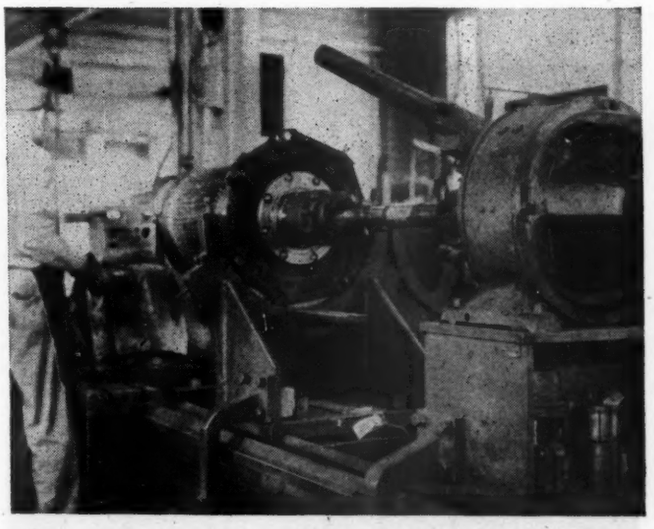
PART I of this article, which appeared in the November issue, showed a layout of details and equipment used in the Rock Island's electrical repair shop at Silvis. It also described the railroad's procedure of testing and inspecting for the purpose of diagnosing the amount of work to be done on each motor, and described the procedure of disassembling and cleaning motor parts preparatory to overhaul. This article covers details on maintenance procedure.

Frames, Fields and Brush Rigging

From the degreaser the several parts of the motor move on progressively through the shop to those locations at which shop machinery is available for their reconditioning. Frames, for example, are taken to the frame section where they are placed on a positioner as shown in one of the illustrations. This requires that a large ring or plate be bolted to each end of the frame in the place of the heads. This ring bears on rollers in the positioner and there are holes near the periphery of one of the rings where dowels may be placed to hold the frame in any desired position. Field coils and pole pieces are removed and later replaced with the aid of an electric jib hoist and a U-shaped member as shown in one of the illustrations.

One very important piece of work done on the frame is checking, and when necessary, restoring the axle-bearing fits in the frame. Play in the housing will cause misalignment of the gear and pinion. The work of restoration consists of building up the worn surfaces by welding and remachining the fits. Enough weld metal is added to give a finish surface after machining.

Report sheets Nos. 2 and 5, respectively, list all the inspection and work requirements for anti-friction bearings and anti-friction bearing housings. Anti-friction bearings are checked for fit in housing, for fatigue flaking, dirt denting, smearing, overheating, electric marks, limiting wear and end play. Anti-friction bearing housings are checked for condition of grease seals, flingers, grease-drain housing, back gap, weight of grease removed, and condition of plates, washers, studs and cap screws.

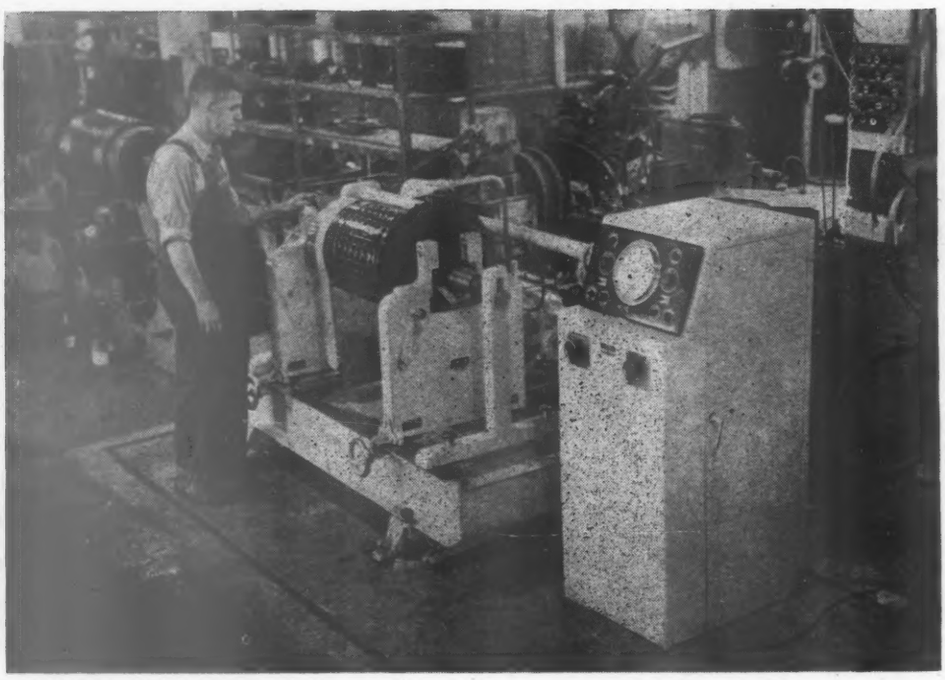


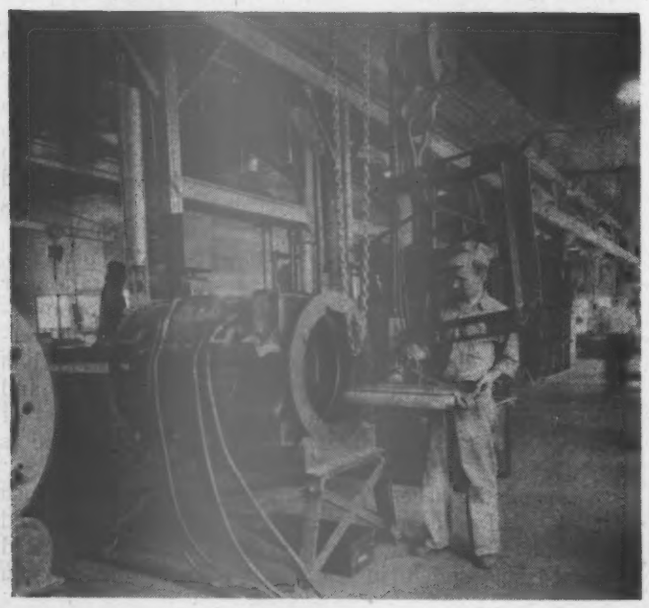
Commutators are ground on their own bearings, using a fixed stone

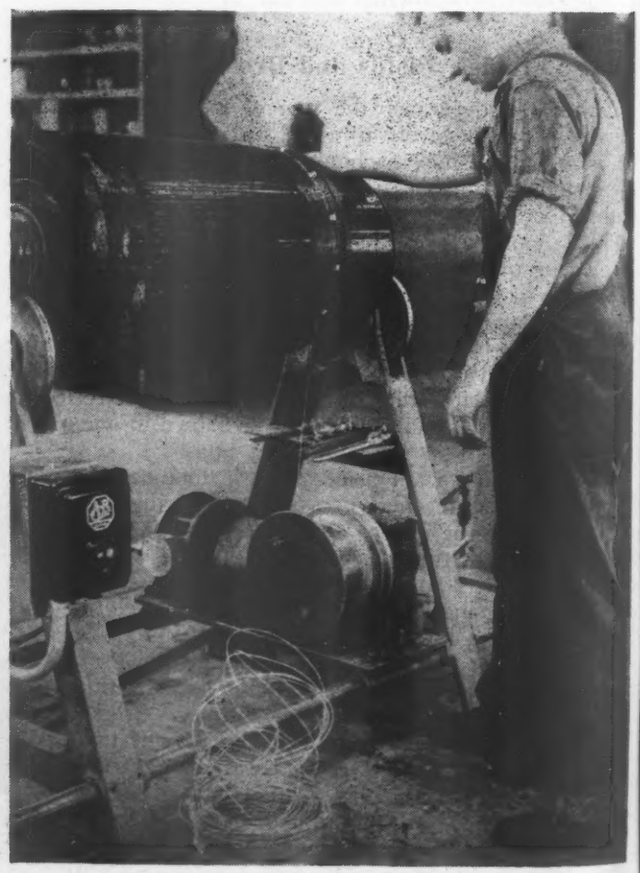
Field coil requirements as listed on Report Sheet No. 3 include checking for looseness, testing on high frequency tester, noting condition of insulation, pole pieces, studs and bolts, spring flanges, washers and shields. Coils are dipped and baked before they are replaced on pole pieces and if retaping is required they are dipped and baked both before and after retaping. Field leads and terminals are restored as their condition requires.

Brush-holder requirements as indicated by Report No. 4 include inspection and when necessary restoration or replacement of brush-holder supports, terminal connections, porcelain insulators, shunts, pressure arms, pressure-arm tips, clock springs, spring tension, fit in carbon way, pig tail, adjusting sleeve, hinge pin, cotter keys and brushes. All brush holders are given a dielectric test of 4,000 volts for one minute and resistance to ground is measured.

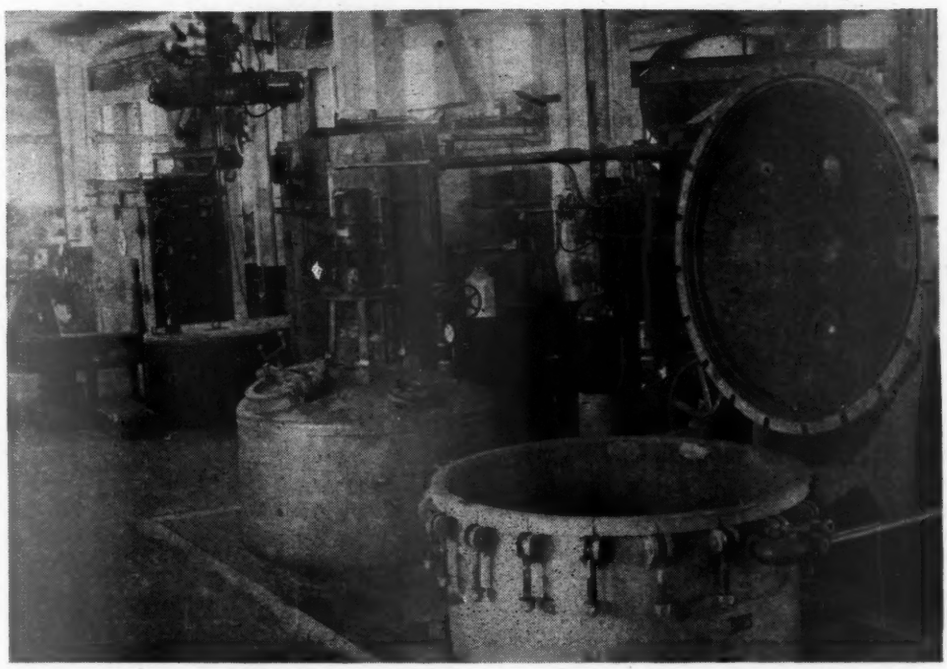
When all the necessary repair work is done on brush rigging, field coils and pole pieces, they are assembled in complete sets and stored in one of the perforated metal baskets shown in one of the illustrations. When







Top row: All armatures are balanced in a dymetric balancer before they are returned to service—Center row: Growler for testing field coils—Lower left: A frame positioner and C bracket for removing and applying field coils and pole pieces—Right: Band stripper (the band wire is wound onto a drum as it is stripped, leaving the wire in an easily handled coil, as shown in the foreground)



Top row: Vacuum impregnating tanks (a dipping tank may be seen in the background)—Center row: Brazing back-end connections of a motor armature—Lower left: The paint spray stand (the motor-driven blower at the right draws air through the grating in the floor and through water sprays and keeps paint spray out of the shop)—Right: Undercutting a commutator

REPORT No. 8

Silvis Shop Automotive Electrical Report

Armature Rewind Progress Report.....Date.....

Shop Order .....Cls. Repairs.....Locomotive No.....

Armature Job No.....Type.....Total Miles.....

Removed from Frame No.....

Cause of Failure.....

Manuf. of Coils.....No. of X Coils.....

Armature Coil No.....By.....

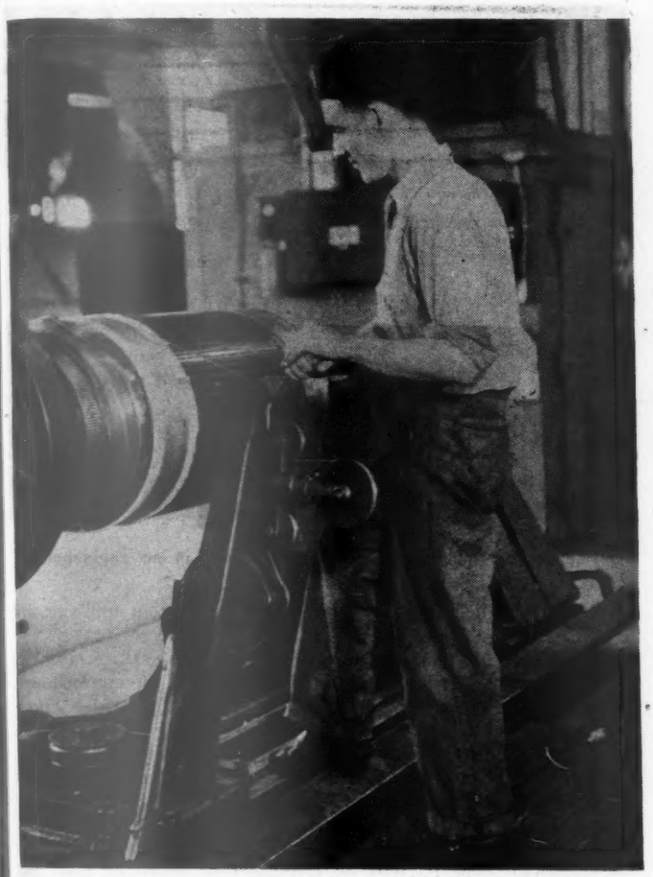
No.	Operation	Performed By
1.	Flingers removed from shaft	
2.	Shaft checked OK.	Regrind / Replaced
3.	Shaft Magnafluxed	Old / New
4.	Shaft removed started	Tons out / Tons
5.	Shaft checked after grinding	
6.	Shaft replaced	New / Old
7.	Bands removed	
8.	Wedges removed	
9.	Flange	Fan / Removed
10.	Coils removed	
11.	Lead removed from commutator	
12.	Commutator risers cleaned	
13.	Commutator tested for shorts	Volts
14.	Commutator removed	
15.	Com. Mica segments replaced	No.
16.	Com. copper segments replaced	No.
17.	Com. front Vee replaced	Manuf.
18.	Com. back Vee replaced	
19.	Check com. for alignment & tightened cold	
20.	Check com. hot	Tons / Pressure
21.	Check com. cold	Tons / Pressure
22.	Check com. hot	Tons / Pressure
23.	Check com. cold	Tons / Pressure
24.	Checked for alignment	
25.	Commutator checked for shorts	Volts
26.	Commutator resist to grd.	Megohms
27.	Apply string band	
28.	Hipot 4,000 volts 1 minute	
29.	Clean & inspect P.E. coil support	
30.	Clean & inspect C.E. coil support	
31.	Clean laminations	
32.	Replace center lamination	All / No.
33.	Replace end lamination	All / No.
34.	Commutator pressed on shaft	Tons
35.	Insulated P.E.	
36.	Insulated C.E.	
37.	Heat armature 1 hr.	
38.	Band P.E. insulation	
39.	Band C.E. insulation	
40.	Cool armature	
41.	Remove bands P.E.	C.E.
42.	Apply com. filler for X coil	
43.	Wind X coils bottom	
44.	Apply com. filler for top X coil	
45.	Cement X coil bottom	
46.	Insulate between X coils	
47.	Wind X coil top	
48.	Cement X coil top	
49.	Test X coil bar to bar	Volts
50.	Test X coil bar to second bar	Volts
51.	Heat armature 2 hours	
52.	Bend X coil	
53.	Apply insulation over X coil	
54.	Band insulation over X coil	
55.	Cool armature	
56.	Remove X coil bands	
57.	Test com. bar to bar and to second bar	Volts
58.	Test resist to ground	Megohms
59.	Hipot X coil 3,500 volts 1 minute	
60.	Place P.E. winding fixture	
61.	Lay off armature	
62.	Place bottom grd. insulation	Inch
63.	Place U pieces	
64.	Wind bottom coil	

No.	Operation	Performed By
65.	Insulate between coils	
66.	Heat armature 2 hours	
67.	Band insulation	
68.	Place fillers	
69.	Place insulation between coils in slots	
70.	Wind top coils	
71.	Place steel slot bars	
72.	Heat armatures 3 hours	
73.	Band armature	
74.	Cool armature	
75.	Remove winding fixture	
76.	Resist to ground	Megohms
77.	Hipot 3,000 volts 1 min.	
78.	Silver solder clips	
79.	Insulate clips	
80.	Apply expander	
81.	Apply end bell and mica	
82.	Apply P.E. mica hood	
83.	Prepare com. for soldering	
84.	Test com. with ductor for shorts	
85.	Solder com.	
86.	Heat armature 1½ hours	
87.	Band clip	
88.	Check grease collar	
89.	Apply spacer and grease collar	
90.	Turn commutator	
91.	Machine spacer	
92.	Test armatures with ductor	
93.	Test armatures for grounds	
94.	Dip armature	
95.	Baked armature 4 hours	
96.	Cool armature to 120 deg. F.	
97.	Band P.E. mica hood	
98.	Wedge armature	
99.	Wedge material	
100.	Wedges purchased	
101.	Wedges manufactured at Silvis	
102.	Remove balance of bands	
103.	Apply band insulation	
104.	Apply core bands	
105.	Apply P.E. band	
106.	Apply C.E. band	
107.	Resistance to ground	Megohms
108.	Hipot 2,500 volts 1 minute	
109.	Tighten com. hot	lbs. tension
110.	Tighten com. cold	lbs. tension
111.	Tighten com. hot	lbs. tension
112.	Tighten com. cold	lbs. tension
113.	Tighten com. hot	lbs. tension
114.	Tighten com. cold	lbs. tension
115.	Heat com. for vacuum impregnation 10 hrs.	
116.	Vacuum impregnate as per instructions	
117.	Bake armature 16 hrs.	
118.	Cool armature	
119.	Dip armature	
120.	Baked armature 16 hrs.	
121.	Dynamic balance	
122.	Grind commutator	
123.	Undercut mica	
124.	Bevel commutator bars	
125.	Burnish commutator	
126.	Paint Vee ring with 1201	
127.	Air dry overnight	
128.	Sand Vee ring very lightly with 2/0 sand paper	
129.	Paint Vee ring with 1201	

a motor is ready for reassembly, the contents of any basket may be used.

Armatures

When armatures do not require rewinding, they proceed through the shop from one work position to the next. Records are made on Report Sheet No. 7 of the



Armature banding machine

mileage since the armature was previously in the shop, since the previous band removal and previous clip inspection. Shaft sizes are measured and recorded and, when necessary, friction bearings are ground to the next undersize and fitted with a sleeve. When a shaft is removed or applied the pressure required is recorded. All shafts are Magnafluxed.

The armature is given a bar-to-bar test and examined for loose leads, soft bars, flat spots on commutator, loose wedges, condition of bands and laminations. Bands are replaced every 600,000 miles or four years. The armature is also given a high-frequency test and a record is kept on the report sheet of the work done by each operation, such as application of temporary or permanent bands, soldering of bands, application of string bands and hoods, tightening commutator and application of mica rings or fans.

After this work is done the armature is dipped and baked, dried in a vacuum, impregnated, baked, dipped, baked, dipped and baked. Resistance to ground is measured and a high-potential test applied.

The armature is then balanced dynamically and the commutator tested for loose bars. If there are loose bars, the Vee ring is tightened both hot and cold in a press. The commutator is then ground, undercut and burred. Pinions are Magnafluxed.

If rewinding is necessary, the armature moves through the northeast or lower left section of the shop, as shown in the diagram, before passing to the armature finishing tools at the lower right. Report Sheet No. 8 lists in detail each progressive step of the work to be done together with a space for the signature of the operator doing the work. A complete copy of the sheet is shown.

Assembly

When a motor is assembled, the work is recorded on Assembly Report No. 6. A record is made of the shop order, class of repair, the job number of frame, fields, armature and brush holders, type of motor, name of manufacturer, motor serial number and the name of the worker performing each operation of assembly and adjustment.

After the field coils, brush holders and leads are in place, the motor frame is moved from the positioner to the spray stand where it is painted inside with a red oil-proof lacquer and outside with a dark blue lacquer. As all other parts of the motor are painted as they are finished, it is only necessary to assemble the motor and then touch up the bolts, washers, etc. This touching up is done with a paint brush, so it is not necessary to bring the motor back over the paint-spray stand. This operation is shown in one of the illustrations. After an insulation resistance and high-potential test, the armature and heads are applied. End-play and clearance measurements are made and brushes applied and sanded. Brushes are placed on neutral and measurements taken of brush spacing and of the clearance between brush holders and the commutator.

On sleeve-type bearings the motor is run for two hours, after which the heads are removed and high spots in the babbitt scraped off and lateral adjusted. Heads are then replaced and the motor run for six hours continuously, and if the temperature does not rise beyond an established amount above room temperature, the bearings are considered O.K. and the motor is ready for shipment. On anti-friction bearings the motors after

One of the two baking ovens

being assembled are run until the temperature begins to drop; this time varies from one to three hours. Pinions are lapped to the shaft before application and applied by heating and advancing them the required distance on the shaft taper. To prevent the pinion from being advanced to the unlapped portion of the shaft, the shaft is undercut at the edge of the lapped portion.

Finished motors move out of the west or right end of the shop and are shipped to stores or to the point where they are to be applied to a locomotive.

Electrical Section Reports

THE Committee of Direction, Electrical Section, Engineering Division, A.A.R., met in Chicago on October 15, 1944, to discuss the six reports published this year by the Section and to plan for future activities. Among the six reports presented there were three which included technical information of value to electrical men in railroad service. These were, respectively, the reports of the Committee on Power Supply, Electrolysis, and Track and Third-Rail Bonds, abstracts or summaries of which follow:

Use of Capacitors

Data on the subject of the use of capacitors was prepared by three railroads. The Southern Pacific Company installed a total of 300 kva. in capacitors at three locations in its Sacramento, Calif., general shops in 1940, primarily to improve power factor, and thus defer the installation of increased transformer capacity, as well as additional copper in its 4-kv. distribution lines. The improvement of the power factor of the load effected a saving of about $1,000 in 1943 in the cost of energy.

The energy purchased in 1943 amounted to 14,335,000 kw-hr., at an average cost of 0.729 per kw.-hr. The results obtained by installing capacitors in 1940 are illustrated in the table.

How Capacitors Affected the Power Factor at Sacramento Shops

Year	Half-hour demand, Kilowatts		Power factor		Kva. at Max. kw. Demand
	Min.	Max.	Min.	Max.	
1936	2,070	2,700	71	76	3,550
1937	2,460	2,670	72	76	3,510
1938	1,920	2,496	73	79	3,160
1939	2,376	2,760	77	80	3,450
1940*	2,520	2,832	77	89	3,180
1941	2,616	2,928	88	90	3,260
1942	2,712	3,336	87	90	3,170
1943	2,928	3,408	88	91	3,750
1944	3,072	3,480	89	90	3,870 6 mos.

* Capacitors were installed late in 1940.

It will be noted that, while the minimum demand between 1936 and 1944 (up to June 30) increased 48 per cent, and the maximum demand 29 per cent, the kva. at maximum demand increased only 9 per cent.

The Canadian National installed capacitors ranging from 50 to 200 kva. in capacity at five locations during the last few years. These were appdied with the idea of obtaining reductions in the charges for power rather than economy in transformers or copper, although they made the increased capacity available. These installations have or will have paid the installation costs within less than two years.

The Illinois Central has installed capacitors totaling 350 kva. in capacity at five locations to obtain a reduction in the power charges where the power factor clause was included in the contract. At another location 300 kva. capacity was installed to increase the capacity of both transformers and copper. In addition, capacitors were installed on a number of signal power lines to obtain improvement of voltage.

Inside Power Feeders

In connection with this study on means for conserving labor and materials, including the adaptation of substitute non-critical materials, the Committee on Power Supply presented a brief report on the advantages realized by installing power feeders inside enginehouses instead of on the exterior of the outer circle wall. This part of the report reads as follows:

It was formerly the practice of the Illinois Central to install power feeders for enginehouses on the outer circle wall, using weatherproof cable on insulators or secondary racks attached to the outside of the wall. A tap was made for each stall and brought in through the wall, using a service head, fuse cutout and conduit at each stall.

Inside feeders mounted on distribution racks in an enginehouse

To conserve both labor and material these feeders are now run on secondary racks or insulators on the inside of the enginehouse, thereby saving considerable labor and material, and also eliminating the trouble experienced in northern territory with icicles that form on the eaves and drip directly on the cables.

The wiring system now employed for lighting the enginehouses makes extensive use of non-metallic sheathed cable—often the rubberless type—saving rubber, conduit and fittings.

In the wiring of yard offices, small shops, etc., the railroad is now employing type EI wire on insulators or knob and tube and also type EI non-metallic sheathed cable, and making extensive use of all-porcelain outlet boxes, switch boxes and covers.

The report is signed by C. R. Sugg (chairman), electrical engineer, A.C.L., (retired); C. P. Trueax (vice-chairman), assistant engineer, electrical department, Ill. Cent.; R. Beeuwkes, electrical engineer, C.M.St.P.&P.; Cleve Bowser, c/o superintendent motive power, Virginian; H. F. Brown, assistant electrical engineer, N.Y.N.H.&H.; D. J. Brumley, retired chief engineer, Chicago Terminal Improvements; Paul Lebenbaum, electrical engineer, So. Pac.; R. J. Needham, mechanical and electrical engineer, C. N.; J. A. Shaw, general electrical engineer, C. P.; E. G. Stradling, superintendent telegraph and signals, C.I.&L.; and D. B. Thompson, mechanical and electrical engineer, N.Y.C.

Corrosion of Steel in Concrete

For the past two years the Committee on Electrolysis has been conducting tests concerned with the corrosion of steel embedded in concrete. For the purpose of the experiments made during the past year a test site was selected on the right-of-way of the Illinois Central near 23rd Street in Chicago, and specimens were placed and the test building erected. Heavy busses were run from the test house to the specimens. A General Electric Tungar charger in the test house supplied the necessary voltage and current, the same potential to ground being maintained on all specimens and the amount of current flow to each one measured. The specimens consisted of 1-in. iron rods embedded in cylindrical sections of concrete, varying in diameter from 3 to 25 in. The concrete was made in a variety of mixtures (in some cases admixtures of other materials were used) and some of the concrete sections were enclosed in steel pipe, while others were given a

(Continued on next left-hand page)

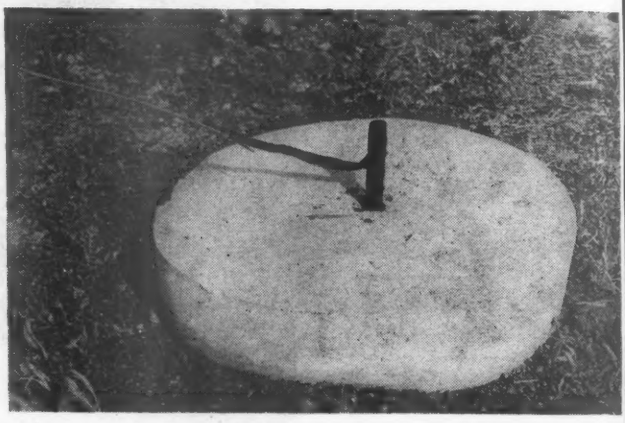
Current Flow in Electrolysis Specimens

Specimen No.	Diameter, in.	Covering	Mix	Admixture	I amp.	R to grd., ohms
1	3	None	1 cement, 3½ sand	None	1.20	30
2	3 *	None	1 cement, 3½ sand	None	.83	37
3	3	None	1 cement, 3½ sand	None	1.10	27
4	5	None	1-3-5	None	.94	..
5	5	None	1-3-5	None	.88	..
6	5	None	1-3-5	None	1.00	..
7	9	None	1-3-5	None	.94	..
8	9	None	1-3-5	None	1.15	..
9	9	None	1-3-5	None	1.02	..
10	13	None	1-3-5	None	.90	..
11	13	None	1-3-5	None	.92	..
12	13	None	1-3-5	None	.84	..
13	25	None	1-3-5	None	.79	36
14	25	None	1-3-5	None	.90	35
15	25	None	1-3-5	None	1.05	29
16	6	Steel	1-3-5	None	1.28	21
17	6	Steel	1-3-5	None	1.40	19
18	6	Steel	1-3-5	None	1.42	20
19	10	Steel	1-3-5	None	1.10	..
20	10	Steel	1-3-5	None	1.00	..
21	10	Steel	1-3-5	None	1.10	..
22	5	Asphalt	1-3-5	None	.10	400
23	5	Asphalt	1-3-5	None	.11	325
24	5	Asphalt	1-3-5	None	.08	500
25	13	Asphalt	1-3-5	None	.29	..
26	13	Asphalt	1-3-5	None	.42	..
27	13	Asphalt	1-3-5	None	.17	..
28	5	None	1-2-3	None	.80	..
29	5	None	1-2-3	None	.87	..
30	5	None	1-2-3	None	.95	..
31	13	None	* 1-3-5	None	*	..
32	13	None	1-2-3	None	1.10	..
33	13	None	1-2-3	None	.90	16
34	5	None	1-3-5	None	*	..
35	13	None	1-2-3	None	1.04	..
43	13	None	1-3-5	Celite	.95	32
44	5	None	1-3-5	Morene	.97	32
45	13	None	1-3-5	Hydrated Lime	.98	14
46	13	None	1-3-5	Morene	.91	34
47	1	Bare steel rod		....	..	..
48	5	None	1-3-5	Hydrated Lime	.84	28
49	1	Bare steel rod	1-3-5	....	..	..
50	5	None	1-3-5	Celite	.97	30

* Specimen for 60 cycle a.c. test.

Note: Temperature about 45 to 50 deg. F. Ground wet, raining most of time, high wind.

Readings taken April 11, 1944.



Above: Asphalt waterproofed concrete specimen, 13-in. dia., 1-3-5 mix—Below: Plain concrete specimen, 25-in. dia., 1-3-5 mix

coating of asphalt. With all specimens connected in parallel, a potential of 50 volts was applied to the connecting busses, and the amount of current flow to each specimen was measured, with results as shown in the accompanying table. Values of resistance to ground were obtained by means of a Megger tester.

A survey of the values in the table indicate clearly several definite characteristics: (1) The thickness of the concrete covering had little effect, as witnessed by the similarily of current values (and resistances) for the 3-in. and 25-in. specimens; (2) the specimens with admixtures gave similar results to all others except the asphalt coated, although one specimen showed a markedly lower resistance to ground with the Megger tester; (3) the asphalt-coating was by far the best insulating medium used; (4) similar specimens in the several busses had comparable currents and ground return resistance in most cases.

Some questions have been raised as to whether the differences in the ground return distances would cause differences in the test results, especially in the amount of electrolysis over a period of time. The length of the specimen in the ground (5 ft.) will also tend to equalize and reduce the ground resistance because of the larger earth volume thus available for conduction. Further measurements on ground resistance will be made this fall. Some bare rods have been driven into the test plot and it is expected to use them to get some indication of the resistances of the ground path itself as a separate quantity from the resistance of the specimen coverings.

Current readings have been continued from time to time as opportunity afforded and on August 10, 1944, a transformer was installed and 60-cycle current applied to specimens 31 and 34 at 40 volts. This value was selected to give comparable currents with respect to the d.c. specimens. The d.c. voltage was reduced to 25 volts to cut down the load on the charger and also because this is more comparable to the maximum voltage found in some cases of service.

The several sets of readings are seen to be fairly consistent with most of the values decreasing somewhat. The initial readings were taken during a period of considerable rainfall and the later ones during rather dry weather. Of course, the location being near the lake on filled ground, the water level is likely to be rather high.

(*Continued on next left-hand page*)

View of field test arrangement showing building, busses, specimens and protective fence

55 LIMA 2-8-4 LOCOMOTIVES

TO SPEED TRAFFIC ON THE NICKEL PLATE

In 1941 the Nickel Plate ordered fifteen Lima 2-8-4's. The performance of these super-power locomotives was so highly satisfactory in making possible the handling of heavier trains at greater speeds, that the Nickel Plate has steadily increased its fleet of this type.

Its latest order for an additional fifteen will give it a total of fifty-five of these powerful Lima Locomotives to meet today's tremendous traffic demands.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

Steel-encased concrete specimen, 10-in. dia., 1-3-5 mix

The test program was undertaken because of damaging effects of current flow to ground through reinforced concrete structures. One of the most self-evident methods of minimizing such flow and the resultant electrolytic effects on the reinforcing steel is to provide better insulation between the steel and the ground return path. Various methods have been advocated for this purpose. These include the use of a thicker concrete covering, richer concrete, the addition of admixtures to the concrete, steel casing to prevent cracking and to exclude moisture, and coating with waterproofing material.

The most important tentative conclusion of these tests to date is that there is little difference in the insulating properties of the various methods except in the case of the asphalt coating. The specimens with the asphalt coating show current flows of the order of only about 1/10 that of the other methods. Passage of time may modify this result so that further results should be awaited before final conclusions are drawn.

Data on the actual effects of the current flow will, in general, have to await completion of the program of measurement of the current flow variations.

One of the suggested methods of increasing the insulating value of concrete is to aerate it by various methods. No specimens representing this method were incorporated in the field test, but some concrete block specimens have been supplied by the Portland Cement Association, and the resistance of these blocks dry and immersed in water will be determined in the laboratory and compared with that of the concrete used in the field test specimens.

The report is signed by A. E. Archambault (chairman), assistant engineer, N.Y.C.; H. P. Wright (vice-chairman), assistant electrical engineer, B.&O.; R. Beeuwkes, electrical engineer, C.M.St.P.&P.; D. P. Dickie, Western Union Telegraph Company; Paul Lebenbaum, electrical engineer, So.Pac.; P. L. Mathewson, assistant engineer, C.N.; W. P. Monroe, consulting engineer; G. K. Shands, electrical foreman, Virginian; J. S. Thorp, electrical engineer, D.L.&W.; J. M. Trissal, electrical engineer fixed property, Ill.Cent.; S. M. Viele, assistant electrical engineer, Pennsylvania.

Effect of Welding on Bonds

Assignments given to the Committee on Track and Third-Rail Bonds include the effect of rail-end welding on welded bonds caused by gas and electric welding and also the question of injury to pin-type bonds due to rail-end welding and heat treatment. Methods of prevention were also considered in all cases. The experience of members was collected by questionnaire and is summed up in the following:

Effect on Welded Bonds by Building Up Rail Ends By the Gas-Weld Process

Reading.—(12,000 volts a.c.)—Bond used is No. 1 AWG, 61 strand or rope lay type. Failure of these bonds is greatest in sections where rail ends have been built up by the gas-weld process, despite instructions to use asbestos wool as a covering, which protects the bond from the direct effect of the flame. However, the heat used is so severe as greatly to reduce the life of the bond. It is the conclusion that there is no method by means of which the bond can be protected when gas is used to build up rail ends.

C. M. St. P. & P.—(3,000 volts d.c.)—Bond used is No. 4/0 U type, 7 in. long, with standard stranding, gas weld. Bonds are seriously damaged in building up rail ends. Bonds are now removed with a track chisel, the cut being made so that welding material is left attached to the rail, this being removed before the bond is reapplied.

Pennsylvania.—(600 volts d.c.)—Bond used is 250,000 c.m. copper, 147 or 156 strands, with copper or brass sheaths, developed length, 16 in. Territory in which welded bonds are used is not embraced in the program for rail-end welding. When welding has been done in isolated cases, the bond is removed and therefore no injury occurs.

Southern.—Welded bond is used in signal territory and is shown on A.A.R. Signal Section Drawing 1047-A. Experience is similar to that of the Reading, i.e., failure of bonds is due to heat generated when rail ends are built up by the gas-weld process.

Illinois Central.—(1,500 volts d.c.)—Bonds used are No. 4/0 straight or U bonds, double strand, 61 wires each, gas weld. In 1942, rail ends on 40 miles of track were built up. Bonds were about 16 years old and were covered with asbestos during building-up of rail ends. As of date, damage to bonds is not excessive, because welders directed the flame away from the bond. Most of the damage occurred on the straight bonds, the majority of which were about ready for removal. This railroad does not believe it economical to remove and replace bonds during rail end welding, because of labor cost; furthermore, 50 per cent of the life of the bond would be destroyed in removal and replacement.

Tests indicate that the temper of the strands is reduced by at least 70 per cent in the initial application of bonds to the rail, and still further if the rail ends are built up by the gas-weld process.

Delaware, Lackawanna & Western.—(3,000 volts d.c.)—Bonds are No. 4/0 U type, flame weld. Some failures experienced in building up rail ends, which is done by welding, a strip 1 in. wide by 2½ in. long in the center of the rail head. By keeping the flame away from the bonds, bond injury is reduced to a minimum. No method of preventing injury to bonds is used.

Southern Pacific.—Bonds used are signal welded type, 7 in. by 19/16 in. diameter rope lay, bronze stand. They have been applied on all newly laid rail, none of which, as yet, has had ends built up. In certain districts, where galvanized iron signal bonds are installed around the joints, welded bonds have been applied for broken rail protection inside of the joints. However, not enough rail ends have been built up in these latter cases to arrive at any definite conclusion, although it is believed that the bonds would be damaged if left in place.

American Steel & Wire Company.—Some years ago, tests were made to determine the actual temperature of the bond conductor close to the terminal. Both traction (No. 4/0) and signal (7 by 19) bonds were used. Tests were made with the oxy-acetylene flame, it being the opinion that more heat would thus be transferred than if the electric arc were used, because with the latter the heating is more localized near the top of the rail. The tests showed that the use of wet asbestos packing materially reduced the temperature of the bonds; in actual practice, however, it is seldom used. The table records the results obtained in the laboratory; the location listed in the table refers to the distance of the terminals of each bond on either side of the rail joint.

Laboratory Tests of Bond Protection

Type of bond	Protection used	Location, in.	Temp. deg. F.	Breaking load	Required B.L.
BW-2	Asbestos	3 & 2	575	4,400	4,200-5,000
BW-2	None	2 & 9	1,000	3,560	4,200-5,000
BF-1	Asbestos	3 & 2	760	3,930	3,250-4,225
BF-1	None	2 & 8	990	4,100	3,250-4,225
BD-2	Asbestos	2 & 9	310	5,400	3,250-4,225
BD-2	None	3 & 9	985	5,500	3,250-4,225

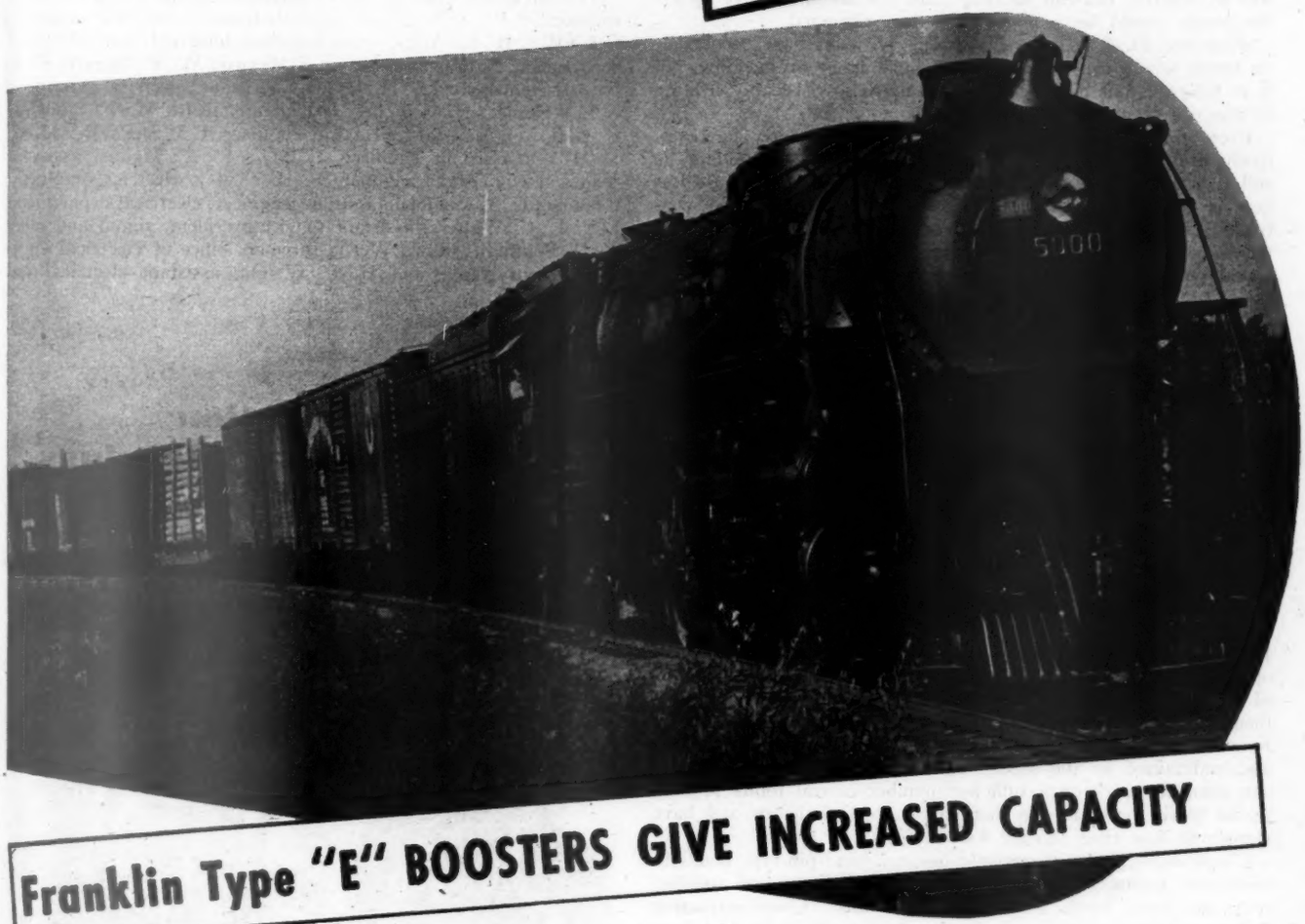
It will be noted that in these tests the packing is effective in lowering the temperature of the bond, and at the same time does not improve the breaking load.

Effect on Welded Bonds By Building Up Rail Ends By the Electric-Weld Process

Reading.—(12,000 volts a.c.)—Has had no experience, but believes that this method would cause much less damage to bonds than is experienced with the gas-weld process.

(*Continued on next left-hand page*)

MORE POWER ... FOR SOO LINE 4-8-4's



Franklin Type "E" BOOSTERS GIVE INCREASED CAPACITY

The Soo Line has applied Franklin Type E Boosters to its 5000 Class 4-8-4 locomotives and thereby gained a substantial increase in capacity.

The additional power provided by the Franklin Booster permits the hauling of heavier trains over the severe grade out of Minneapolis.

On the road the Booster aids the locomotive in maintaining its schedule by furnishing extra power to move in and out of sidings, to accelerate quickly to road speed, and for other grades and tight spots.

These advantages can be secured by any railroad through the application of Franklin Type E Boosters to its locomotives.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.
NEW YORK • CHICAGO
In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

C. M. St. P. & P.—(3,000 volts d.c.)—Has found that it is not necessary to protect the welded bonds with this process as the bonds are not seriously affected.

Southern Pacific.—Welded type bonds have been applied on all new rail, none of which so far has required building up of the ends. Although it is expected that bonds will be damaged less by electric rail-end welding than gas welding, nevertheless the bonds would be removed and then reapplied.

American Steel & Wire Company.—No tests have been made on bonds where rail ends are being built up by arc-welding, but it is believed that damage would be much less, because heating of the rail is more localized near the top.

From the foregoing the following conclusions may be tentatively drawn: Less lamage to bonds is caused by building up rail ends by electric welding than when gas is used, because less heat is generated and because the arc can be more rapidly controlled. The wet asbestos pack constitutes effective protection, but is seldom used. In the end, removal of the bond, if of the signal type, is the only certain method of preventing injury.

Injury to Pin-Type Bonds Due to Rail-End Welding By the Gas Process

Reading.—Uses signal-type railhead bonds on new rail projects on its entire system, but has not built up rail-ends in any territory where these bonds have been installed. Is of the opinion that, if the bonds are to be saved for reinstallation, the rail end welding crew should remove the original bond, install a spare (which could be used over again several times) and then replace the original bond, after cleaning the holes.

Pennsylvania.—(12,000 volts)—Pin-type rail-head bond is removed before heat is applied to the rail head. After the rail has cooled, the holes are cleaned to remove any deposit and then the bond is applied.

Southern.—Uses A.A.R. Signal Section bonds per Drawing 1048-B. Bonds are generally removed before heat treatment, but opinion is equally divided between the advantage and economy of retracting bonds for re-use before heat treatment or leaving them in place until after the heat treatment is completed, then removing and replacing with new bonds. All bonds are installed and maintained by the signal department. Unless track forces can complete work on a sufficient number of rail joints to keep signal forces busy, it does not pay to remove bonds and have signalmen lose time waiting for welders.

Virginian.—Has comparatively few rail-head pin-type bonds in electrified territory. However, during recent rail-end welding with gas, some bonds were left in the rails. Upon extracting the bonds after welding, it was found that the holes had been oxidized. It was concluded that there was no advantage in leaving the bonds in the holes, as most of the bonds were destroyed and their presence did not prevent oxidation. It was also found that the resistance of a new bond installed in holes that had been cleaned was as good as where new holes had been drilled.

Southern Pacific.—Bonds are Signal Section standard applied on rail laid only five or six years ago. Because of this, no program for building up these rail ends has been established. On the comparatively few occasions where a rail head had to be built up, it was found that the hole is oxidized if the bond is removed, and removal of this film, even if carefully done, leaves the original hole larger, and sometimes deeper than before. If the bond is left in place, and removed upon completion of the weld, cleaning of the hole is less of a problem, but the bonds themselves are rendered useless.

General.—One member is of the opinion that, temperatures being high in rail-end welding, any rail-head bond applied thereon suffers severely and should be replaced, or removed before and reapplied after the welding operation.

In the case of pin-type bonds, it may be better to leave them in the rail during the welding operation; after the rail has cooled, any damaged bonds are removed, the holes inspected and cleaned, if necessary, and new bonds installed. This procedure protects drilled holes from extreme oxidation and coating deposited by the welding operation.

No specific reference is made to the effect of electric welding in any of the replies, although the general impression seems to be that bonds are not damaged to as great an extent as with gas welding.

From the foregoing, practically the same conclusions may be drawn for the pin-type bond as for the welded bond under Assignment No. 2; however, the effect of heat treatment, not included in Assignment No. 2, should be added to these conclusions.

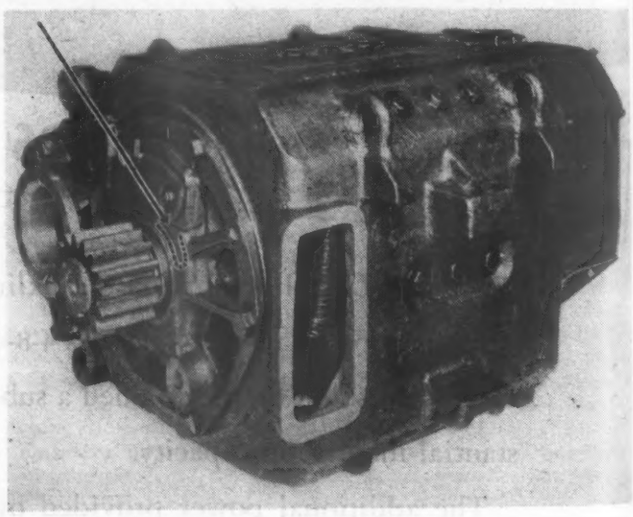
In heat treatment of rail ends, involving higher temperatures than for building up rail ends by electric or gas welding, bonds must be removed if they are to be reused.

The report is signed by Paul Lebenbaum (chairman), electrical engineer, S.P.; J. S. Thorp (vice-chairman), electrical engineer, D.L.&W.; B. E. Arias, superintendent telegraph and electrical department, National Railways of Mexico; W. P. Bovard, Ohio Brass Company; H. F. Brown, assistant electrical engineer, N.Y.N.H.&H.; H. H. Febrey, American Steel & Wire Company; C. G. Lovell, assistant electrical engineer, C.M.St.P.&P.; H. G. McMillan, assistant engineer, N.Y.C.; R. A. Mylius, assistant electrical engineer, Virginian; S. R. Negley, electrical engineer, Reading; C. R. Wadham, assistant engineer, electrical department, I.C.; L. C. Walters, assistant to vice-president, signal and electrical, Southern; R. C. Welsh, foreman, office of electrical engineer, Pennsylvania, and H. P. Wright, assistant electrical engineer, B.&O.

Improved Lubrication For Traction Motor Bearings

By taking advantage of an incidental detail of design, a considerable reduction in the wear of pinion-end bearings on General Electric No. 287 motors has been obtained on the Boston & Maine.

In the view of the motor shown the pinion-end oil well is located in the casting below and behind the pinion. It so happens that on these motors there is a small cored-



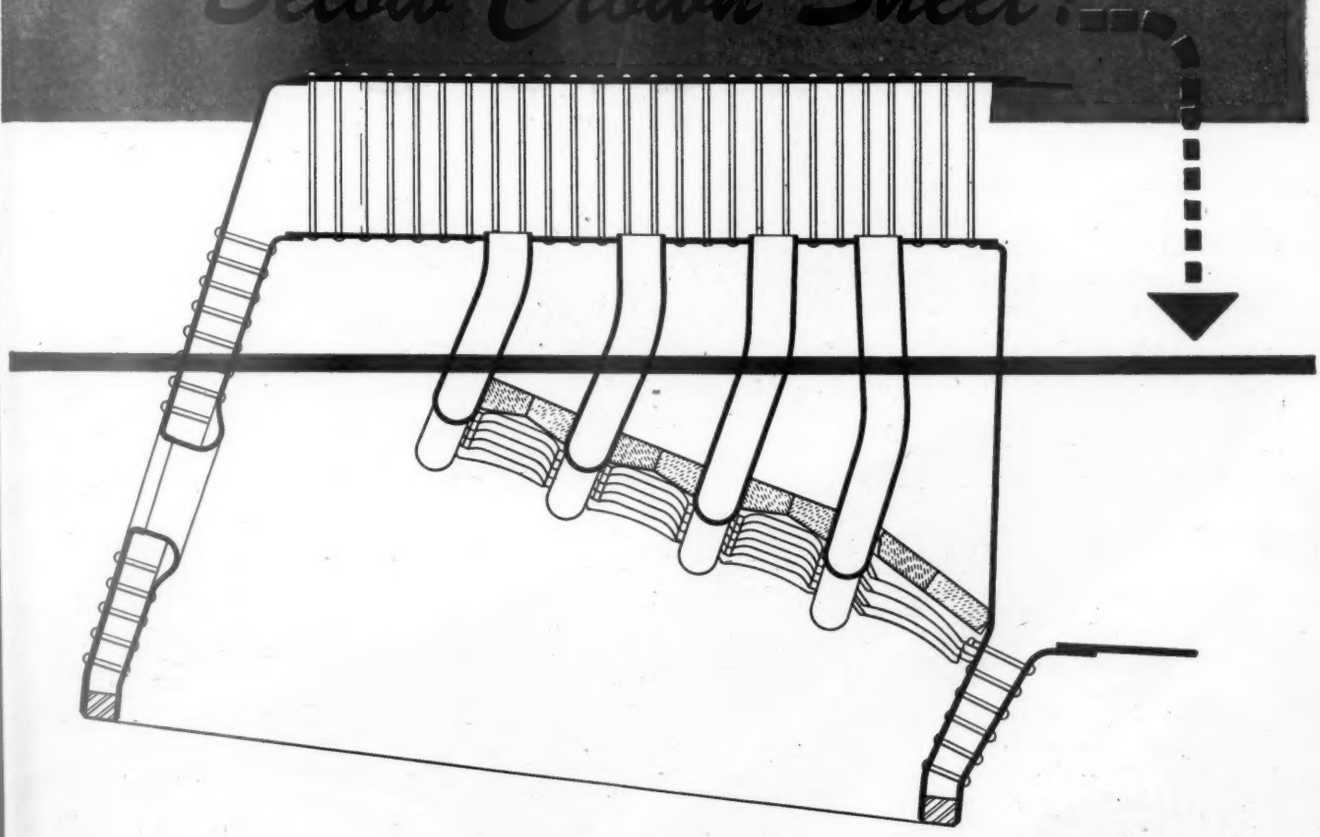
G-E Type 287-E motor showing location of the cored-out section referred to in the article

out section, the location of which is indicated by the curved line. This pocket will hold about a quart of oil. Normally, oil for lubricating the bearing is carried up from the regular oil well by stranded waste which bears against the side of the shaft. On the B. & M., the lubrication is supplemented by filling the cored-out section with oil and carrying four strands of waste from this oil to the upper end of the waste in the regular oil well above the point where it contacts the shaft. This procedure adds a sufficient amount of oil to measurably extend the life of the bearing and will put lubrication on a monthly basis for 24-hour switching service.

The scheme was developed by P. J. Hamman, Diesel-electric foreman of the railroad.

(*Turn to second left-hand page*)

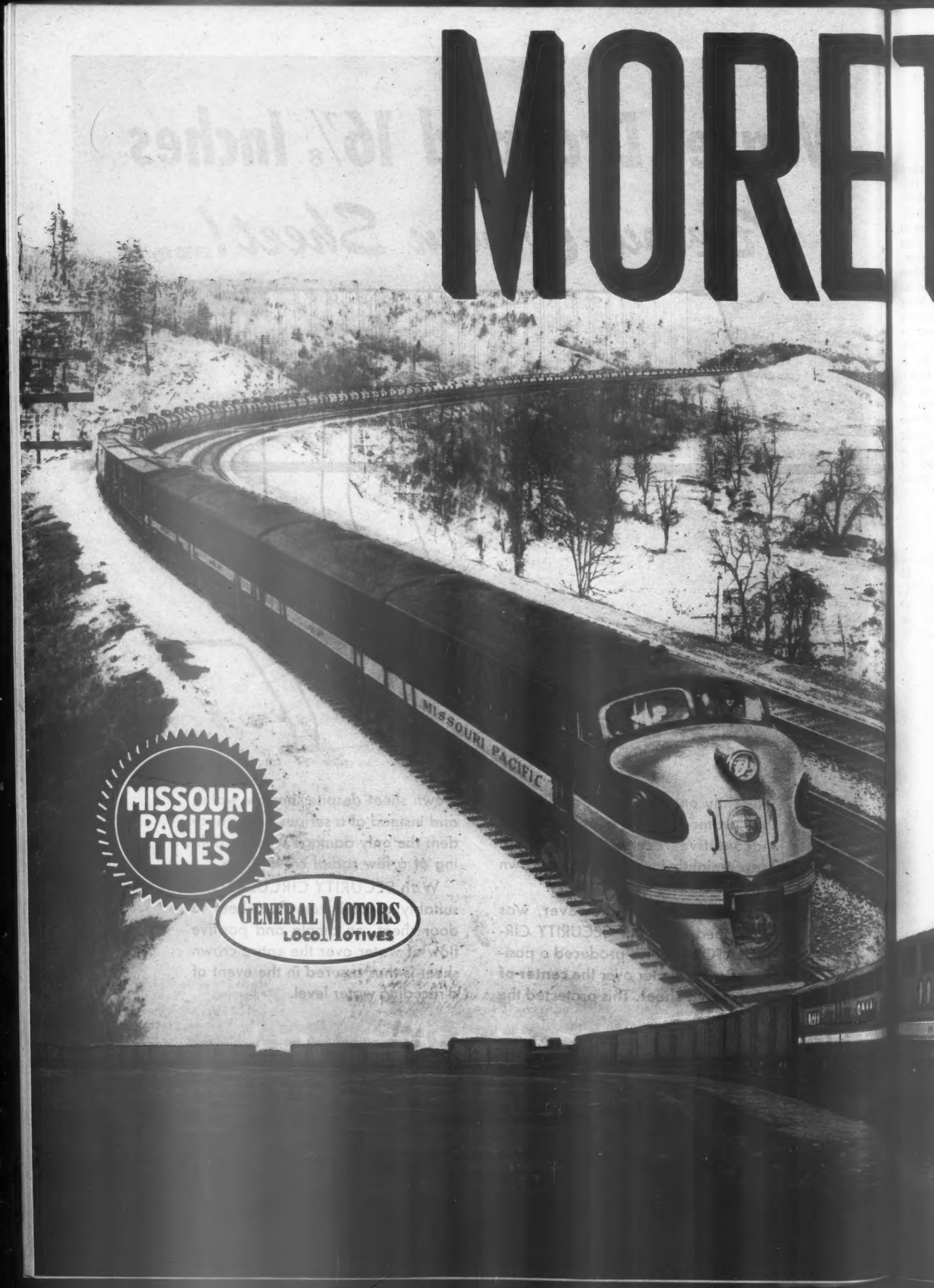
Water Dropped 16⅞ Inches Below Crown Sheet!



Recently on a midwestern railroad, the water level in a Mikado type locomotive receded sixteen and seven-eighths inches below the crown sheet.

The locomotive, however, was equipped with four SECURITY CIRCULATORS, which produced a positive flow of water over the center of the crown sheet. This protected the crown sheet despite the low water, and instead of a serious boiler accident the only damage was the pulling of a few radial crown bolts.

With SECURITY CIRCULATORS suitably spaced from flue sheet to door sheet, an ample and positive flow of water over the entire crown sheet is thus assured in the event of a receding water level.


MORE
MISSOURI PACIFIC
MISSOURI PACIFIC LINES
GENERAL MOTORS
LOCOMOTIVES

TON-MILES

MORE TON MILES per unit—per day—per year and for every dollar spent for fuel ... that's the record of General Motors Diesel Freight Locomotives... On the Great Northern one of the GM Freight Diesels hauls 33 per cent more tonnage with a 25 per cent saving in time... On the Missouri Pacific the first GM Diesel broke all existing load and speed records on this road... On the B & M a 5400 Hp. GM Diesel cut 3 hours and 35 minutes off the schedule of a daily freight train in the short distance of 186 miles... On the Rio Grande the records show 53.6 more locomotive miles per month, former tonnage handled 13.7 per cent faster and an increase of 45 per cent more gross ton miles per day.

★ *ON TO FINAL VICTORY — BUY MORE WAR BONDS* ★

ELECTRO-MOTIVE DIVISION

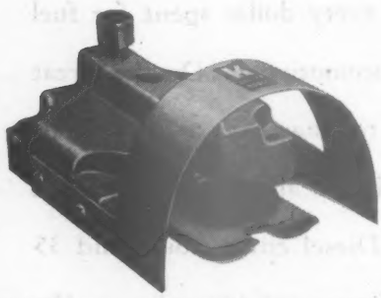
GENERAL MOTORS CORPORATION LA GRANGE, ILLINOIS, U. S. A.

NEW DEVICES

Three-Way Foot Valve

A compressed-air foot valve to be used with air tools, air cylinders, air chucks, flash welders, forging machines, die-casting machines, riveting machines, air vises, and all other air-operated equipment is announced by the manufacturer, Keller Tool Company, Grand Haven, Mich.

On tools where it is desirable for operators to have both hands free it facilitates rapid handling of work. Safety for the operator is assured by the kick guard which prevents accidental operation.



Three-way foot valve which is protected against accidental operation

This foot valve is furnished in locking and non-locking types. The pedal lock on the locking type holds the pedal in the open position. A touch of the operator's toe releases the lock. A simple adjustment of the lever-locking device prevents engagement of the operating pedal and changes the locking type to the non-locking type.

The valve mechanism is simple. Normally, the valve is closed with the outlet side open to the exhaust. When the foot pedal is depressed, the exhaust closes and line pressure is admitted to the device to be operated. Upon release of the pedal, the air supply stops and the outlet to the exhaust is again opened.

Joint Sealing and Anti-Seize Compound

A pipe-joint, stud- and bolt-thread compound which is composed of a high percentage of superfine metallic lead particles suspended in an unctuous medium is recommended by its manufacturers, I. H. Grancell Company, 1601 East Nadeau Street, Los Angeles, Calif., for a variety of railroad uses. The product is marketed under the name Bestolife Lead Seal No. 270 Joint-Sealing and Anti-Seize Compound.

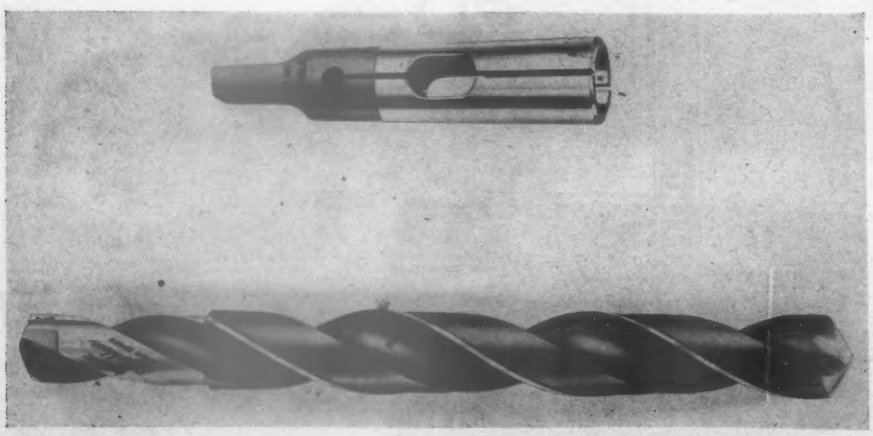
The compound is said to lubricate threads as a joint is being made up and permits the threads to be cold when drawn together in tightening. By reducing friction, the compound prevents fusion of the threads, galling or seizing. Fittings can be drawn up to their maximum points and tight shoulder-to-shoulder contacts made. The compound is not a cement and does not harden on lines carrying steam, air, water or oil. It can be applied with a brush and may be left exposed to the air without any change in its characteristics.

Suggested uses are on staybolts, frame connection bolts, firebox studs and bolts, threaded parts of superheater units, throttle valves and rigging, steam and exhaust piping, feedwater heaters, boiler feed pumps, injectors, stokers, gages and air-brake lines. It can also be used to lubricate rod and link pins to prevent wear.

Shankless Twist Drill

The Republic Drill & Tool Company, Chicago, is introducing a high-speed drill with a continuous flute which is produced by roll-forging and hot-twisting and which is driven by a removable taper shank or "drill-driver." This tool, originally developed by an engineer of the Ford Motor Company, has been used as a standard for years by that company but is only now being manufactured for use in the general tool market.

Among the advantages claimed for this drill is one of lower initial cost per drill. This is offset somewhat by the cost of drill-drivers. The usable portion of the flutes of the new drills is from 25 to 40 per cent greater than that of conventional high-speed, taper-shank drills. The shankless drill is tougher and stronger because of its heavier web construction and the neck or driver end is toughened by heat treatment to resist torsional strains. These factors contribute to reduced drill breakage. The accuracy and concentricity of the drills is said to equal that of the conventional types. There are 135 sizes of drills between ¼ in. and 2 in. diameter which require the use of seven different sizes of drill drivers. These drivers are hardened and ground tools made to withstand severe service and their life is equal to that of a considerable number of the shankless drills which are used in them.



Drills are inserted in a drill driver and replaced only when worn out. The drill driver requires only infrequent replacement

Diesel Air Filter

The Far-Air Diesel air filter for engine intakes announced by Farr Company, 2615 Southwest Drive, Los Angeles 43, Calif., has a capacity of 2,200 to 3,200 cu. ft. per minute. As illustrated, the filter, weighing 45½ lb., is complete and ready for attachment. It is composed of four separate filter panels of herringbone-channelled fine wire screen 2⅛ in. thick. They are mounted with spring clips on a steel frame which permits easy removal for cleaning or changing while the unit is in normal operation. The overall size of the unit is 14 in. by 14 in. by 22⅛ in., and the actual filter size is 8¾ in. by 22 in. by 2⅛ in.

Filter for Diesel engine air intakes

NEWS

U. P. Diesel Goes 1,049,000 Miles Without Major Overhaul

DIESEL-electric locomotive No. 9-M-1A of the Union Pacific, one of six normally assigned to its Kansas City-Denver run, completed more than 1,049,000 mi. from August, 1940, to September 30, 1944, without a major overhaul and, according to present plans, it will not be shopped until sometime in 1945. The performance of this locomotive follows those of the "City of Denver" of the U. P. Chicago & North Western, each of which traveled more than 3,000,000 mi. in eight years without being shopped for repairs.

Construction of Streamliners Awaits Release of Materials

THAT a new era of streamline passenger-train construction awaits the release of materials and manpower is indicated by plans recently disclosed by several railroads, including the Great Northern; the Louisville & Nashville; the Chicago & North Western; the Illinois Central; the Atchison, Topeka & Santa Fe; the Chicago & Eastern Illinois; the Southern Pacific; the Chicago, Rock Island & Pacific; the Pere Marquette; the New York Central and the Northern Pacific.

In some instances, locomotives and cars have been definitely ordered while in others, the program for the construction of the trains may extend over a period of three to five years.

Shop and Equipment Programs

Atchison, Topeka & Santa Fe.—The Santa Fe has begun a program for the rebuilding of 1,500 50-ton box cars in its shops at Topeka, Kan., because of the manpower shortage, which limits the force to 350 men, the output per day since November 1 has been six cars.

Chicago, Rock Island & Pacific. This road has begun complete reconstruction and rearrangement of its coach yards and shops at Chicago, which will be completed at a total cost of $1,190,000. Included in the project will be the relocation of wheel pits and water, air, steam and gas lines, and the construction of a new testing laboratory, oil-storage building, steel, machine, cabinet, electric, pipe, tin and airbrake shops, and office, locker and stock rooms. The new yard will have nine service tracks separated by concrete platforms and one track for handling spare wheels. An automatic car washer will be installed through which trains will pass as they are brought into the yard.

Reading.—The Reading has authorized the reconversion of 20 consolidation type steam locomotives of 2-8-0 wheel arrangement into modern 4-8-4 type freight locomotives in its Reading, Pa., shops at a cost of approximately $2,800,000. New tenders will be applied to the engines. Construction is scheduled to begin in May, 1945 and the program calls for an output of two locomotives each month.

St. Louis-San Francisco.—The trustees of the Frisco have been authorized by the federal district court at St. Louis to spend $549,500 for the purchase of seven Diesel-electric switching locomotives.

Train Communication Tried in France

A 90-MILE test run, featuring end-to-end radio communication, was made recently somewhere in France, by an operating battalion of the Military Railway Service, and "encouraging results" now have been reported by the Office of Director General, M. R. S.

This was accomplished by the use of radio, Two 4-lb. "walkie-talkie" sets were borrowed from the C. B. S. Signal Section, and installed on the front and rear end of the train.

During a 90-mile round-trip, perfect communication was maintained all the time, except for a few moments while passing through a tunnel. At one station during a layover, the possibilities of radio for yard operations were tried out. It was found to be of great value in a switching yard, since car numbers could be given directly to the operator as they were read off, eliminating the written tabulations and delay in carrying them from the yard to the operator. Now the yard men are reported to favor quick adoption of the plan.

Emphasis on Freight Diesels Heavy in '44

DEVOTING a section of the November issue of its Monthly Comment on Transportation Statistics to Diesel locomotives, the Bureau of Transport Economics and Statistics of the Interstate Commerce Commission directs attention to Association of American Railroad figures which reveal that the new Diesel-electric freight locomotives installed by Class I line-haul roads during the first nine months of this year showed an aggregate tractive force in excess of the freight steam tractive force added in the same period—18.9 million pounds, compared with 18.5 million pounds. The I. C. C. Bureau calls this "relatively heavy emphasis on freight service Diesels" the "most interesting and, perhaps, significant feature of these 1944 figures from a long run standpoint."

The A.A.R. figures show that all Diesels installed in the first nine months of this year had an aggregate tractive effort of 41.4 million pounds. The I. C. C. Bureau calculated that this increment in less than one year "was equivalent to approximately 35.3 per cent of the entire tractive force of locomotives of this type reported by Class I line haul railways at the end of 1943, after nearly two decades of growth."

Trolley Gives Current for Cooking on Swiss Dining Car

DESPITE a growing raw material shortage, and similar difficulties confronting Swiss industry, the Swiss Federal Railroads attempt to do what they can to modernize rolling stock, advises the Official Information Bureau of Switzerland, in New York. This agency now reveals that early this year, a new type of first- and second-class passenger car was inaugurated, which reduced the tare from 40 tons (heavy and medium weight coach) to 28 tons. Primarily intended for use by light express trains, these cars cost about 180,000 Swiss francs each.

This bureau also announces a new type dining car which is being put in service. It features a trolley, whereby current for the electric stove in the kitchen is obtained directly from the overhead power wire. The car weighs 33 tons, 15 tons less than the old cars.

Orders and Inquiries for New Equipment Placed Since the Closing of the November Issue

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Alton	3[1]	Diesel-elec. pass.	Electro-Motive
Great Northern	5[2]	Diesel-elec. pass.	Electro-Motive
Missouri Pacific	1,000	50-ton box	American Car & Fdry. Co.

FREIGHT-CAR INQUIRIES

Central of Georgia	100-200	50-ton pulpwood	
Chicago, St. Paul, Minneapolis & Omaha	400	50-ton box	
	100	50-ton hopper	
Grand Trunk Western	500	40-ton box	
Great Northern	500	50-ton gondola	
New York Central	1,000[3]	70-ton gondola	
New York, Chicago & St. Louis	500	50-ton box	

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Great Northern	For 5 trains[2]		Pullman-Standard

[1] Authorized by Federal District Court at Chicago. For use between Chicago and St. Louis. Cost, $349,220 each. Expected to effect a yearly saving of $25,000. Will release three steam locomotives.
[2] For "Empire Builder." The five streamline trains will cost $7,000,000.
[3] For Pittsburgh & Lake Erie.

(*Turn to second left-hand page*)

D. L. Murray Manufacturing Com- author of a book for children "On the Rail- Carnegie-Illinois Steel Corporation,

Supply Trade Notes

CATERPILLAR TRACTOR COMPANY.—*Lyle E. Hill* has been returned to the engine sales department of the Caterpillar Tractor Company, Peoria, Ill., as head of the department's railroad power division. Mr. Hill has served Caterpillar as a priorities supervisor and special traveling representative of the purchasing department for the past two

Lyle E. Hill

years. In the railroad power division, he will contact U. S. and Canadian railroads in furthering the sale of Diesel-electric switching locomotives, in conjunction with the several manufacturers who power their locomotives with Caterpillar engines. Mr. Hill joined the Caterpillar Tractor Company in 1941 after having served for more than 19 years with the Chicago & North Western. He received his machinist apprentice training with that railroad and subsequently served as a motive-power officer.

◆

BRIGGS CLARIFIER COMPANY; M. N. DANNENBAUM COMPANY.—The Briggs Clarifier Company has appointed the M. N. Dannenbaum Company, Houston, Tex., as its distributor in east Texas and the Gulf coast territory and McGregor & Werner, Inc., Washington, D. C., as its distributor in Maryland, Delaware, and the District of Columbia.

◆

NATIONAL BATTERY COMPANY.—*C. P. Judge,* an engineer of the Westinghouse Electric & Manufacturing Company, with headquarters at Wheeling, W. Va., has resigned to become divisional manager of the Pittsburgh district of the Gould Commercial division of the National Battery Company. *Leslie E. Howard* has been appointed sales engineer for the Spokane and Salt Lake City territories of National and *A. J. Miller* has been made sales engineer for the Detroit district.

◆

WORTHINGTON PUMP & MACHINERY CORPORATION.—*William J. Van Vleck,* assistant manager of the Philadelphia, Pa., district office of the Worthington Pump & Machinery Corporation, has been appointed manager of the company's Atlanta, Ga., office to succeed *Edward Sauverman,* who has resigned to engage in another line of business. *C. W. Camp,* formerly with the Crocker-Wheeler Electric Manufacturing Company for 38 years, has become associated with Worthington as consulting engineer.

◆

LIMA LOCOMOTIVE WORKS.—*Albert Jay Townsend,* who has been appointed vice-president in charge of engineering, as announced in the November issue, is a graduate of Michigan University with a degree in mechanical engineering (1915). He began his career with Lima as calculator in 1917. Following military service as master engineer with the American Expeditionary Force in 1918, he returned to Lima in July, 1919, and subsequently served successively as chief calculator, mechanical engineer and chief mechanical engineer.

◆

LUKENS STEEL COMPANY.—*Herbert B. Lewis* has been appointed manager, machinery division, of the Lukens Steel Company and its subsidiaries, By-Products Steel Corporation and Lukenweld, Inc. Mr. Lewis had been associated with the Brown & Sharp Manufacturing Company, Providence, R. I., for the past 25 years.

◆

AMERICAN BRAKE SHOE COMPANY.—The Henry Marion Howe Medal of the American Society for Metals has been awarded to three members of the staff of the American Brake Shoe Company's metallurgical laboratory at Mahwah, N. J., *Earnshaw Cook,* chief metallurgist; *J. A. Fellows,* assistant chief metallurgist, and *R. A. Flinn,* assistant metallurgist, for the best paper to appear in the Society's publication

John S. Hutchins

"Transactions." The metallurgists' paper described a quantitative study of the transformation reaction of steel from high to low temperatures as related to heat treating practices.

John S. Hutchins, vice-president in charge of sales of the Ramapo Ajax division of the American Brake Shoe Company, has been appointed to the newly created position of executive vice-president of the division. Following his graduation from Yale University in 1925, Mr. Hutchins joined the operating and engineering department of Ramapo Ajax. He subsequently served in the sales department and was sales manager for two years before his elevation to a vice-presidency.

Robert Boyd Parker has been appointed assistant to the president of the American

Robert Boyd Parker

Brake Shoe Company. His duties include sales research and coordination, and responsibility for liaison between the company's metallurgical and research laboratories and the sales and production staffs of its 59 plants. Mr. Parker was graduated from Yale University.

◆

REPUBLIC STEEL CORPORATION.—Plans for a large expansion in its production and sale of high-strength, low-alloy steels to meet anticipated postwar demands for lightweight equipment in the transportation field have been announced by the Republic Steel Corporation. *N. J. Clarke,* vice-president in charge of sales, stated that Republic has acquired license rights for the manufacture of Cor-Ten and Aldecor steels, which it will market in addition to its own trademarked product, Republic Double Strength Steel. Cor-Ten is a patented steel produced by Carnegie-Illinois Steel Corporation, and other subsidiaries of the United States Steel Corporation, and Aldecor, the result of research by the Alloys Development Corporation of Pittsburgh, Pa., was developed by the Republic Steel Corporation.

◆

AMERICAN WELDING COMPANY.—*M. A. Cornish,* superintendent, has been appointed in full charge of the Carbondale, Pa., plant and office of the American Welding Company, wholly owned subsidiary of the American Car and Foundry Company. Mr. Cornish joined the plant in February, 1916, and was appointed assistant superintendent in 1921 and superintendent in 1932.

D. J. Murray Manufacturing Company.—*Henrik J. Eklund* has been appointed chief engineer of the D. J. Murray Manufacturing Company, Wausau, Wis. Mr. Eklund has been associated with the designing and development of paper and pulp mill machinery, both in the United States and Finland, since 1933.

◆

Kropp Forge Company.—*J. E. White,* project manager in charge of construction, procurement and equipment for the new plant of the Kropp Forge Aviation Company, Chicago, has been appointed sales engineering representative in northern Illinois for the Kropp Forge Company, with headquarters in Rockford, Ill.

◆

American Car and Foundry Company.—*Otto Kuhler,* industrial designer in the railroad field, has been retained by the American Car and Foundry Company as design engineer of passenger-train car equipment for the postwar period. Under the arrangement made the American Car and Foundry Company will have the exclusive benefit of his services beginning November 1. Mr. Kuhler studied electrical and mechanical engineering in European schools and is a graduate with a degree in mechanical engineering of a prominent European technical university. He came to the United States in 1922, working in Pitts-

Otto Kuhler

burgh, Pa., for a time as a commercial artist. He subsequently turned his attention to the railroad field and developed a design for a streamline locomotive which was described in the July 25, 1931, issue of the Railway Age and which has since, with some modifications, developed into the standard for locomotive design. Soon thereafter, Mr. Kuhler became associated with American Locomotive Company and, in collaboration with engineers of that company and of the Chicago, Milwaukee, St. Paul & Pacific, was responsible for the styling of the "Hiawatha" trains. He was also retained by the Baltimore & Ohio as a consulting engineer and supervised the conversion of many of the railroad's trains; and designed streamline trains for other railroads. He also has designed buses for the Baltimore & Ohio and for White Motor Company, a subway car for the City of Philadelphia, Pa., and stations for the Milwaukee and the Rock Island. He is the author of a book for children "On the Railroads," and is co-author with Robert S. Henry of the Association of American Railroads of "Portraits of the Iron Horse," which outlines the history of the American locomotive. More recently he has been actively engaged in the development of postwar designs in travel, motive power, cars and stations.

◆

Thomas Machine Manufacturing Company.—*Charles H. Slaughter* has been appointed national sales manager for the Thomas Machine Manufacturing Company, Pittsburgh, Pa. Mr. Slaughter received his education in mechanical engineering at the Carnegie Institute of Technology and

Charles H. Slaughter

the Virginia Polytechnical Institute. He is also a graduate of Cumberland University with a law degree. He began his industrial career as an engineer and designer for the American Steel & Wire Company, the Carnegie-Illinois Steel Corporation, and the Jones & Laughlin Steel Corporation. Mr. Slaughter subsequently established his own machine-tool agency in Texas. Later he became general sales manager of the former Wilmarth & Morman Company of Grand Rapids, Mich., and general manager of the Kent Machine Company, Cuyahoga Falls, Ohio. Before joining the Thomas Machine Manufacturing Company, he was general sales and dealer relations manager for Liberty Plans, Inc., Hamilton, Ohio.

◆

Copperweld Steel Company.—*F. E. Leib,* who has been in charge of the Washington office of the Copperweld Steel Company, has been appointed assistant general manager of sales and *C. H. Jensen,* assistant electrical engineer, has been appointed electrical engineer of the company.

Army-Navy E Awards

DeVilbiss Company, Toledo, Ohio. Third award.

Gould Storage Battery Corporation, Depew, N. Y. Second award.

Koppers Company, American Hammered Piston Ring Division, Baltimore, Md. Third award.

Silent Hoist Winch & Crane Company, Brooklyn, N. Y. Fourth award.

Union Switch & Signal Company, Swissvale, Pa.

Carnegie-Illinois Steel Corporation.—*John A. English,* sales engineer of the Carnegie-Illinois Steel Corporation, Chicago, has been promoted to assistant manager of railroad materials sales.

◆

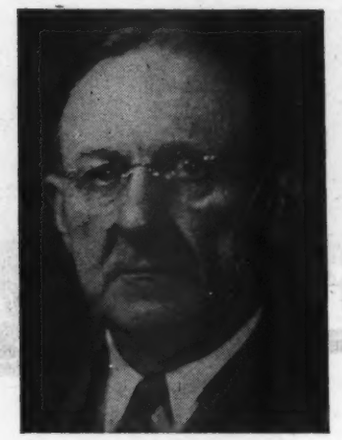
DoAll Company.—The DoAll trade school, organized in July, 1941, has moved from Minneapolis, Minn., to new and larger quarters at 254 North Laurel Avenue, Des Plaines, Ill.

◆

Kennametal, Inc.—*Bennett Burgoon, Jr.,* for several years representative at Rockford, Ill., for Kennametal, Inc., Latrobe, Pa., has been appointed district manager in charge of the company's Detroit, Mich., office, which has been moved to larger quarters at 5531 Woodward avenue.

◆

Durametallic Corporation.—*Samuel A. Schaeffer* has resigned as vice-president and general superintendent of the Clarage Fan Company of Kalamazoo, Mich., to become active president of the Durametallic Corporation of Kalamazoo. Mr. Schaeffer had



S. A. Schaeffer

served as president and chairman of the board of the Durametallic Corporation for many years prior to his new association in an active capacity.

◆

O. C. Duryea Corporation.—*H. S. Keppelman,* for the past two years assistant director—cars, railway transport division of the Office of Defense Transportation, has been appointed vice-president of the O. C. Duryea Corporation, with headquarters in New York. Prior to his appointment with the O. D. T., Mr. Keppelman was superintendent, car department, of the Reading, with which railroad he had been associated in various capacities since 1906.

◆

General Electric Company.—*W. S. Leggett* has been appointed district manager of General Electric Company's transportation division, Cleveland, Ohio, to succeed the late Fred V. Gantt. Mr. Leggett joined the General Electric Company in 1906.

◆

United States Rubber Company.—*Herman A. Everlien* has been appointed general sales manager of the mechanical goods division of the United States Rubber

(*Continued on second left-hand page*)

LOCOMOTIVES THAT ARE MAKING HISTORY

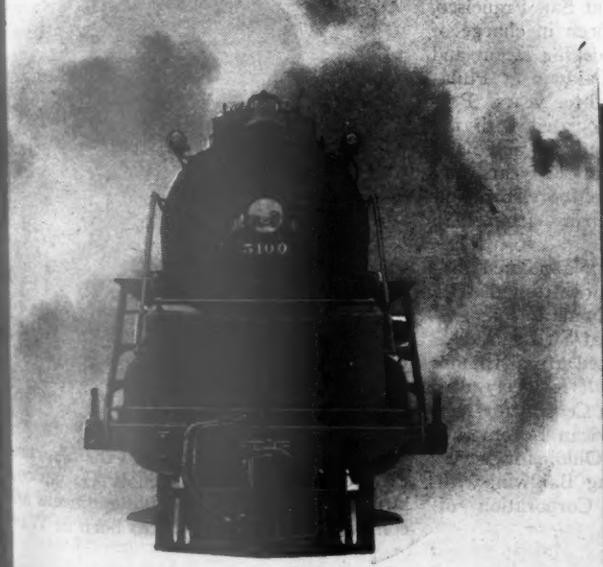
AMERICAN railroading today is demanding more of locomotive builders than ever before. American Locomotive Company is maintaining its long reputation for "delivering the goods"—in locomotive design and construction. Part of an urgent job was the 4-8-4 shown above—one of ten completed early this year by American Locomotive Company for the Rock Island.

Here are the "SPECS":

Weight on Drivers	280,000 lbs.
Weight of Engine	467,000 lbs.
Cylinders	26 x 32 ins.
Diameter of Drivers	74 ins.
Boiler Pressure	270 lbs.
Tractive Power	67,000 lbs.
Tender Type	12-Wheeled

Locomotive designs developed by American Locomotive Company have been, are, and will continue to be powerful factors in American railroad operating efficiency and economy.

● *Another Important Job...this one for* **ROCK ISLAND**



American Locomotive
NEW YORK

DIESEL-ELECTRIC ● ELECTRIC ● STEAM

Company, and *Walter F. Spoerl*, merchandise manager.

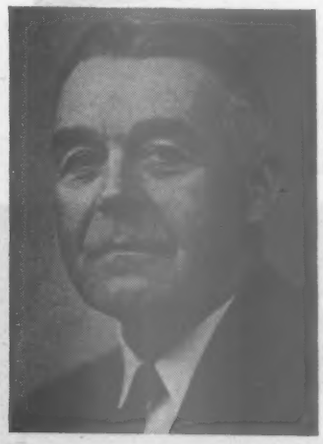
Herman A. Everlien began his career as a clerk in the sales department of the old Revere Rubber Company, Chicago, which was later consolidated into the United States Rubber organization. He became chief clerk in the Revere office, and a salesman in 1913, being responsible for all territory between Chicago and Hastings, Neb. In 1920 he

H. A. Everlien

went to Pittsburgh as a mechanical goods sales manager and in 1924 was transferred to New York as manager of branch sales.

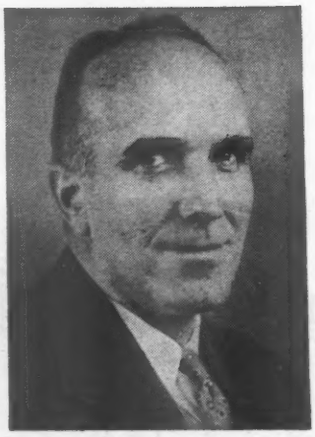
◆

BALDWIN LOCOMOTIVE WORKS.—At the request of the government, the Baldwin Locomotive Works is letting out among several hundred sub-contractors, orders for parts for locomotives now under construction for the government, in order to aid small business in many areas and so spread employment. The orders call for boilers, ashpans, tender frames, dome casings, cabs, steam pipe rings, throat jackets, frame crossties, spark pipes, valve motion forgings, cylinders, connecting rods, pipe nipples, boiler test studs, reverse links and others. The great need for locomotives de-



C. D. Allen

veloped in early 1943. Since then Baldwin has searched the industrial east and middle west for firms capable of turning out parts for these engines. When a plant has been chosen, trained Baldwin men remain on the scene to coach executives and foremen, staying as long as is necessary to smooth out production schedules.



S. W. Moser

S. W. Moser has been appointed Diesel service manager for the Baldwin Locomotive Works, with headquarters at Eddystone, Pa. *G. W. Burnett* has been appointed eastern regional supervisor of Diesel service, also with headquarters at Eddystone. *J. F. Kirkland* has been appointed

W. H. Russell

western regional supervisor, with headquarters at 627 Railway Exchange building, Chicago. *C. D. Allen* has been appointed transportation sales engineer for the Pacific Coast district sales office at San Francisco, Calif. *C. D. Allen* has been in charge of inspection and field service for steam and electric locomotives for Baldwin at Philadelphia, Pa., for the past three years. Previously, he had been associated with the Central Vermont, the Canadian Pacific and the Canadian National for 12 years and with Manning, Maxwell & Moore, Inc., and the J. S. Coffin Jr. Company, from 1926 to 1941.

W. H. Russell has been appointed district manager of the southwestern district sales office of the Baldwin Locomotive Works with headquarters at St. Louis, Mo. Mr. Russell was graduated from Illinois University. *W. H. Russell* formerly was associated with the Illinois Central for several years, with the American Locomotive Company in Cleveland, Ohio, for seven years, and, prior to joining Baldwin, with the Elastic Stop Nut Corporation of Newark, N. J.

LEE HIGGINSON CORPORATION; KERITE INSULATED WIRE & CABLE COMPANY.—The Lee Higginson Corporation has purchased all of the stock of the Kerite Insulated Wire & Cable Co., Inc., sole manufacturers of Kerite Insulation, which is used in railroad, power and telegraph services and in submarine and electronic applications. The long-established policies of the Kerite Company, and the management responsible for them, will be continued.

◆

MT. VERNON CAR MANUFACTURING COMPANY.—*George L. Green* has been appointed vice-president in charge of sales of the Mt. Vernon Car Manufacturing Company

George L. Green

a division of the H. K. Porter Company of Pittsburgh, Pa. Mr. Green was formerly sales manager, railroad and allied industries for the Elastic Stop Nut Corporation. He is a graduate of Yale University (1931) and subsequently served for ten years with the Union Asbestos & Rubber Company, Chicago, as sales engineer, salesman, and assistant vice-president, railroad sales.

◆

MERRITT-CHAPMAN & SCOTT CORPORATION.—*Frederic E. Lyford*, trustee of the New York, Ontario & Western, has re-

Frederic E. Lyford

signed, to become assistant to the chairman of Merritt-Chapman & Scott Corp., construction and marine salvage engineers and contractors. Mr. Lyford was born at Wav-

erly, N. Y., on January 20, 1895, and is a graduate of Cornell University with a degree in mechanical engineering (1916). He was employed variously as an apprentice ship fitter by the Bethlehem Steel Company at Sparrows Point, Md., and as a factory inspector by the Allied Machinery Company at New York until the first World War when he became a first lieutenant, U. S. Army, attached to the air service as an observer. In 1919 he rejoined the Allied Machinery Company as assistant sales manager at New York, and the following year, entered sales promotion work for the Tioga Mills at Waverly. Mr. Lyford began his railroad service with the Lehigh Valley as an apprentice instructor at Sayre, Pa., in 1923 and in 1925 became assistant general machine foreman. Three years later he was named special engineer to the superintendent of motive power at Sayre, and soon after became special engineer to the vice-president there. He served as examiner for the railroad division of the Reconstruction Finance Corporation from 1934 to 1936, when he became assistant to the vice-president of the Baldwin Locomotive Works. In 1937 he was appointed trustee of the New York, Ontario & Western.

Obituary

J. W. SULLIVAN, chairman of the board of Skilsaw, Inc., died on October 26 at Evanston, Ill., at the age of 73 years. Mr. Sullivan became president of the company in 1926 and chairman in 1942.

◆

FRED H. MCCABE of the McCabe Manufacturing Company, Lawrence, Mass., died October 26.

◆

ENOCH BOSTRUM, who has been associated with the Osmose Wood Preserving Company of America, Buffalo, N. Y., since 1935, died October 21. He was the inventor of Osmoplastic, a product of that company.

Personal Mention

General

E. J. FEASEY, special engineer in the mechanical department of the Canadian National, has been appointed chief inspector of Diesel equipment with headquarters at Montreal, Que.

R. D. JOHNSON has been appointed assistant fuel supervisor of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Minneapolis, Minn.

E. J. CRAWFORD, master mechanic of the Chicago & North Western at Clinton, Iowa, has been appointed superintendent of motive power, Western district, with headquarters at Chicago.

J. D. HUSHIN has been appointed rule and mechanical instructor, Southern Ontario district, of the Canadian National, with headquarters at Toronto, Ont.

J. M. PIERCE, general master mechanic of the Kansas City Southern at Shreveport, La., has been appointed superintendent of machinery, with headquarters at Pittsburg, Kan.

W. M. ENGLISH, superintendent of motive power of the Chicago, Indianapolis & Louisville at Lafayette, Ind., has been granted a leave of absence to enter military service as a colonel.

DAVID R. I. HOURSTON, general foreman, motive power shop, of the Canadian National at Moncton, N. B., has been appointed general inspector, mechanical department, at Montreal, Que. His jurisdiction covers the entire system.

PHILIP H. HATCH, mechanical engineer of the New York, New Haven & Hartford at New Haven, Conn., has been appointed general mechanical superintendent, with headquarters at New Haven.

D. F. WILLEY, general mechanical superintendent of the New York, New Haven & Hartford at New Haven, Conn., has been appointed assistant general manager in charge of engineering, maintenance, and mechanical departments, with headquarters at New Haven.

I. I. SYLVESTER, chief inspector of Diesel equipment, Canadian National, at Montreal, Que., has resigned.

S. T. KUHN has been appointed assistant to the general superintendent of motive power of the New York Central, with headquarters at New York.

L. A. PORTER, whose appointment as assistant general superintendent, motive power, of the Seaboard Air Line with headquarters at Norfolk, Va., was announced in the November issue, was born October 17, 1889, in Culpeper County, Va. He is a graduate of Virginia Polytechnic Institute (1910) and attended the University of Edinburgh in 1919. Mr. Porter entered railway service in August, 1910, with the Seaboard Air Line as a clerk and

L. A. Porter

draftsman. From 1912 until 1916 he worked successively for the United States Steel Corporation and the Richmond Cedar Works. He then re-entered the employ of the Seaboard Air Line as a draftsman. He served as a captain in the 29th Division of the U. S. Army in the first World War, and was employed at the U. S. Navy Yard, Norfolk, from August, 1919, until April, 1922, when he returned to the Seaboard Air Line as a draftsman. In January, 1926, he became chief draftsman; May, 1936, mechanical engineer, and in September, 1942, assistant to the general superintendent of motive power.

J. D. WHITE, machinist, has been appointed mechanical inspector of the Canadian National, Atlantic region, with headquarters at Moncton, N. B.

WILLIAM NELSON, superintendent of machinery of the Kansas City Southern at Pittsburg, Kan., has been appointed mechanical assistant to the general manager, with headquarters at Kansas City, Mo.

W. A. BENDER, master car builder of the Alton at Chicago, has been appointed assistant to the general manager, with headquarters at Chicago.

PAUL V. GARIN, assistant engineer of tests of the Southern Pacific, has been appointed engineer of tests, with headquarters as before at San Francisco, Calif.

R. W. DANIEL, master mechanic of the Chicago, Indianapolis & Louisville at Lafayette, Ind., has been appointed acting superintendent of motive power, with headquarters at Lafayette.

E. R. GORMAN, superintendent of motive power and machinery of the Chicago, St. Paul, Minneapolis & Omaha (part of the North Western System), at St. Paul, Minn., has retired. Mr. Gorman was born on December 3, 1879, at Gorman Town, Minn. He entered railway service in April, 1900, as a locomotive fireman in the employ of the Chippewa Valley & Northern, a road owned and operated by the Arpin Hardwood Lumber Company, Bruce, Wis. In September, 1901, he became a locomotive fireman on the Western division of the Omaha. He was promoted to engineman and transferred to the Northern division in February, 1907, but left that company's service in May, 1908, to go with the Northern Pacific, working out of Missoula, Mont. In May, 1912, Mr. Gorman was appointed traveling engineer of the Northern division of the Omaha, with headquarters at Spooner, Wis. In December, 1915, he became trainmaster of the division, and in May, 1917, acting assistant superintendent of the Western division, with headquarters at St. James, Minn. He was appointed permanently to the latter position in November, 1917. In 1919 he was transferred to the Eastern division, with headquarters at Eau Claire, Wis., and in 1920 became superintendent of motive power and machinery.

(*Turn to second left-hand page*)

PEDRO C. MORALES, who resigned in 1943 as general superintendent of motive power and machinery of the National Railways of Mexico, has returned to his former position, with headquarters as before at Buenavista Station, Mexico City, D. F., succeeding Santos Fierro, who has been assigned to other duties. Mr. Morales entered rail-

Pedro C. Morales

way service in 1894 as an apprentice in the employ of the Inter-Oceanic at San Lazaro, and in 1897 he went with the National de Tehuantepec as a foreman, later becoming master mechanic. In 1903 Mr. Morales went with the National Railways of Mexico where he held several minor positions until 1911 when he was appointed assistant general superintendent of motive power and machinery, with headquarters at Mexico City. In 1913 he became general superintendent of motive power and machinery, with headquarters at Mexico City. He resigned from this position in 1916; returned to it in 1920; resigned again in 1925 and a few months later was again appointed general superintendent of motive power and machinery. In 1935 he retired; in May, 1941, was appointed to his former position; in January, 1943, resigned, and on September 1, 1944, again reappointed.

OTTO J. PROTZ, superintendent of motive power of the Chicago & North Western at Chicago, has been appointed superintendent of motive power and machinery of the Chicago, St. Paul, Minneapolis & Omaha (part of the North Western System), with headquarters at St. Paul, Minn. A sketch and photograph of Mr. Protz appeared in the December, 1943, issue of the *Railway Mechanical Engineer* at the time of his appointment as superintendent of motive power at Chicago.

J. C. STUMP, superintendent of motive power of the Chicago & North Western at Chicago, has been transferred to the Northern district, with headquarters at Chicago.

Master Mechanics and Road Foremen

F. L. BAKER, assistant master mechanic of the Chicago & North Western at South Pekin, Ill., has been appointed master mechanic, with headquarters at Chadron, Neb.

W. STEWART has been appointed district master mechanic of the Manitoba district of the Canadian Pacific, with headquarters at Winnipeg, Man.

B. B. BARRETT, assistant master mechanic of the Louisiana & Arkansas, has been appointed master mechanic, with headquarters as before at Minden, La.

J. M. JEFFREY, general enginehouse foreman of the Illinois Central at Chicago, has been appointed assistant master mechanic, with headquarters at Markham (Chicago).

H. P. COX, master mechanic of the Chicago & North Western at Chadron, Neb., has been transferred to the position of master mechanic at Clinton, Iowa.

A. J. PENTLAND, district master mechanic of the Manitoba district of the Canadian Pacific, with headquarters at Winnipeg, Man., has retired.

Car Department

HARVEY A. HARRIS, whose promotion to master car builder of the Alton, with headquarters at Chicago, was reported in the November issue, was born at Renick, Mo., on September 11, 1893, and entered railway service on July 1, 1912, in the car department of the Wabash at Moberly, Mo. He later served as car repairer and car inspector until January, 1916, when he became joint interchange inspector of the Alton and Missouri-Kansas-Texas. In January, 1922, he became car foreman of the M-K-T, and in

Harvey A. Harris

the following year car foreman of the Alton, serving at various terminals. In June, 1925, Mr. Harris was appointed general freight car foreman at Bloomington, Ill.; in October, 1931, general car foreman, and in 1942 general foreman of the car department.

Shop and Enginehouse

THOMAS P. DUGAN has been appointed general supervisor, boiler inspection and maintenance, of the Delaware & Hudson.

R. W. BLACKBIRD, general inspector of shop methods, Canadian National, at Montreal, Que., has retired after nearly 49 years of continuous service.

H. ASKEW, foreman in the tin and pipefitters' shop, car department of the Canadian National at Point St. Charles (Montreal), has been appointed general inspector of shop methods with headquarters at Montreal, Que.

Obituary

WILLIAM M. ANDERSON, who retired in 1937 as master mechanic of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Lewiston, Mont., died recently at San Diego, Calif.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

PRECISION LATHES.—South Bend Lathe Works, South Bend 22, Ind. Catalog 100-D, illustrated in color, has sections on toolroom lathes; quick-change gear lathes; large swing lathes; plain change gear lathes; turret lathes; attachments, features, and specifications.

◆

CUTTING TOOLS.—Robert H. Clark Company, 9330 Santa Monica Boulevard, Beverly Hills, Calif. Catalog No. 44 descriptive of entire line of Clark adjustable cutting tools, with diagrams and illustrations of actual operations, specifications, and prices.

◆

BORING, DRILLING AND MILLING MACHINES.—The Ohio Machine Tool Company, Kenton, Ohio. Bulletin 1000—Ohio Dreadnaught horizontal boring, drilling and milling machines, illustrated.

◆

SWITCHING LOCOMOTIVES. — Fairbanks, Morse & Co., Chicago. Eight-page bulletin and folder. Contains complete general specifications for F-M 1,000-hp. 120-ton Diesel switching locomotives, plan and elevation drawings, also a calculated performance chart showing the power consumption and tractive force developed at various speeds.

◆

MACHINE LUBRICATION INSTRUCTIONS.—The Cincinnati Milling and Grinding Machines, Inc., Cincinnati 9, Ohio. Sixty-two-page booklet of lubricating instructions and specifications for Cincinnati milling, grinding, broaching and lapping machines. Lubrication diagrams.

◆

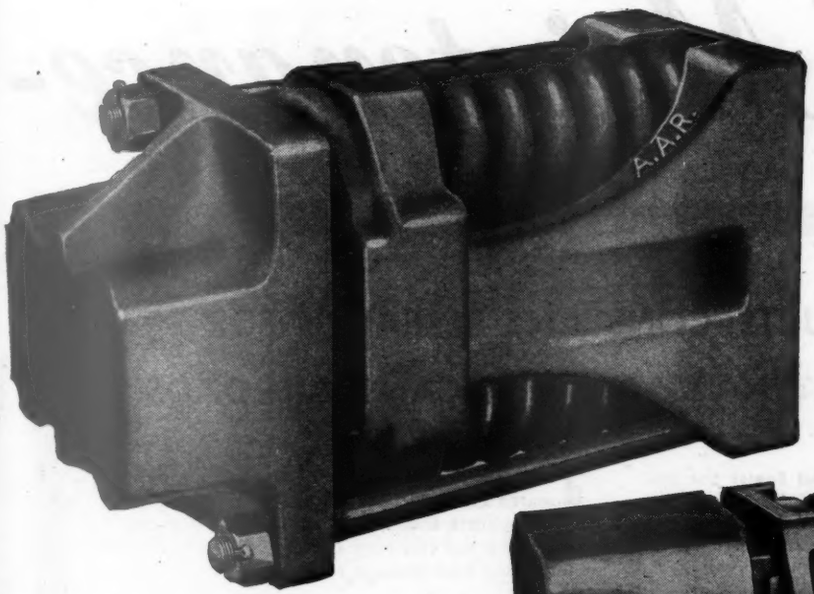
"HARDSTEEL" TOOLS.—Black Drill Company, Division of Black Industries, 1400 East Two Hundred Twenty-Second street, Cleveland 17, Ohio. Twenty-four-page illustrated manual containing revised tables on drilling speeds recommended for drilling hardened steels, amplified instructions on the correct procedure for wet and dry drilling, and complete new information on the application of Hardsteel in tool bits and tool tips used in machining hard, tough steels and abrasive copper and aluminum alloys.

NATIONAL FRICTION DRAFT GEARS

Smooth Action

•

Maximum Shock Absorption



NATIONAL M-17-A DRAFT GEAR
22⅜" long
A.A.R. Approved

NATIONAL M-50-B DRAFT GEAR
20⅛" long
A.A.R. Approved

Long Life
Low Maintenance
High Protective Capacity

NATIONAL MALLEABLE AND STEEL CASTINGS CO.
General Offices: CLEVELAND, OHIO
Sales Offices: New York, Philadelphia, Chicago, St. Louis, San Francisco
Works: Cleveland, Chicago, Indianapolis, Sharon, Pa., Melrose Park, Ill.

GREATER EFFORT TO GET THE UTMOST
THE RAILROAD PLANT. HERE'S...

# of Rolling Stock, of-Way Equipment!

Socony-Vacuum's 78 Years of Lubrication Experience is at Your Service!

FAR BETTER than anyone else, you railroad men yourselves realize the tremendous job still to be done by American railroads. You've stated it concisely and clearly in your messages to the public, as expressed by your Association of American Railroads:

"The road ahead calls for still more effort, still closer cooperation, in getting the utmost transportation service out of our railroad plant."

Socony-Vacuum is assisting you in this greater effort, by giving you this closer cooperation to help solve your greatest problem —the preservation of your present railroad facilities and equipment.

To protect and lengthen the life of your rolling stock, our railroad lubrication engineers are offering you the highest quality oils and greases for every moving part—backed by the greatest lubrication experience in the petroleum industry.

For puzzling lubrication problems arising in your over-worked shops, these same men are at your service with the most complete line of industrial lubricants in the world. Back of them, Socony-Vacuum laboratories are working day and night on current railroad needs.

And for vital maintenance-of-way equipment—automotive-type Diesels and heavy-duty gasoline engines—your Socony-Vacuum representative offers the famous Delvac Series Oils, now serving the armed services on every front.

All of these Socony-Vacuum Services and products are proving invaluable in your present war effort. And when peace comes, they'll be just as essential in your carefully laid plans to keep maintenance and lubrication costs to a minimum. We invite you to take full advantage of them.

SOCONY-VACUUM OIL CO., INC.

Standard Oil of New York Division • White Star Division • Lubrite Division • Chicago Division • White Eagle Division • Wadhams Division
Magnolia Petroleum Company • General Petroleum Corporation of California

ON THE ROCK ISLAND

4 Alco-G.E. Diesel-electrics

How Alco-G.E. Diesel-electrics Have Been Winning the Rock Island's Endorsement

1938 — First 1000-hp Alco-G.E. switcher placed in service

1940 — Three 2000-hp road locomotives placed in service on famous "Rockets"

1941 — Another 2000-hp road locomotive and the first four 1000-hp road switchers. In 1942, these road switchers were released to the U.S. government for overseas duty

1942 — Four more 1000-hp switchers

1943 — Six more 1000-hp road switchers

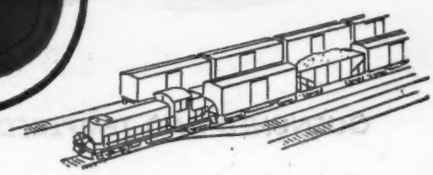
1944 (As of March 1) — Another five 1000-hp road switchers

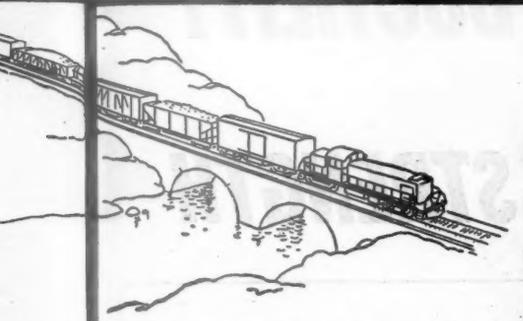
Alco

GE

AMERICAN LOCOMOTIVE

Release 7 Steamers





Alco-G.E. road switchers, available 97 per cent of the time, slash motive-power requirements and speed up freight schedules; also reduce engine-house expense.

ON two Rock Island operations—totaling 525 miles—four 1000-hp Alco-G.E. units are handling the entire motive-power job: switching, accumulating trains, and hauling them on the road.

One result of this versatility has been the release of seven steamers for other work and the elimination of the cost of maintaining servicing stations for them. One terminal, on each operation, adequately cares for all the fueling, inspection, and maintenance needs of the diesel-electrics.

Because they are designed for combination road and switching service, the Rock Island makes full-time use of their 97 per-cent availability. On road trips, these 1000-hp diesel-electrics haul 1350-ton trains up long, curving grades of more than one per cent. Between road trips they are kept busy on switching jobs. At both types of work they are making such effective savings in time that freight schedules have been speeded up—despite an increase in traffic.

The substantial savings produced by the Alco-G.E. diesel-electrics on the Rock Island indicate how effectively you can use them to speed present war traffic and at the same time lower your operating cost to meet future competition.

Our engineers will be glad to survey your system and give you the benefits of our combined total of more than 150 years of railroad experience. And because we build all three types of motive power—diesel-electric, electric, and steam—we can impartially recommend the one which is economically best suited to your particular needs.

These Features Adapt Alco-G.E. Diesel-electrics Particularly to Road and Switching Service

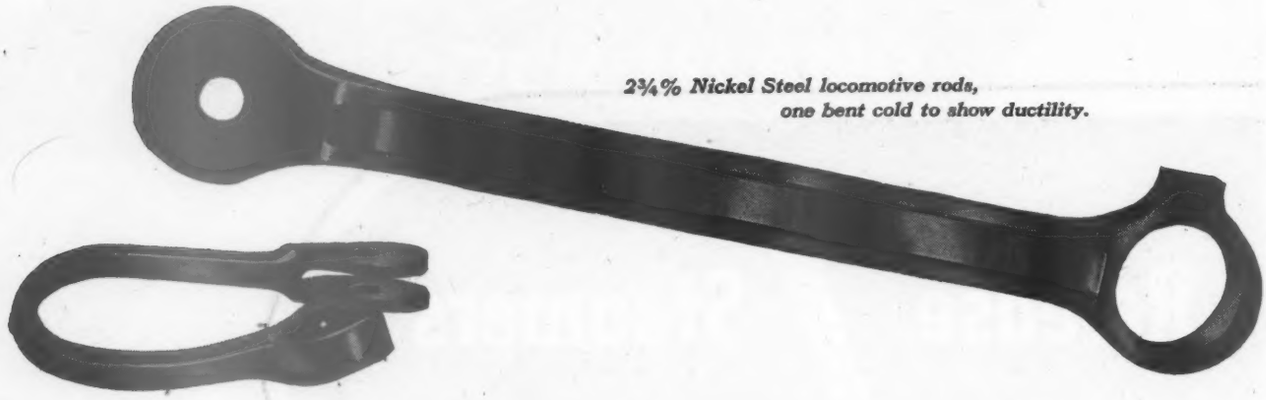
ELECTRIC DRIVE can use all engine power for traction at any speed

EXCELLENT VISIBILITY from cab for fast, accurate, and safe switching

SWING-BOLSTER TRUCKS and 40-foot truck centers for a smooth ride

TRAIN-HEATING FACILITIES for comfortable passenger service

and GENERAL ELECTRIC



2¾% Nickel Steel locomotive rods, one bent cold to show ductility.

QUENCHED AND TEMPERED

NICKEL STEEL FORGINGS COMBINE EXCEPTIONAL DUCTILITY WITH HIGH TENSILE STRENGTH

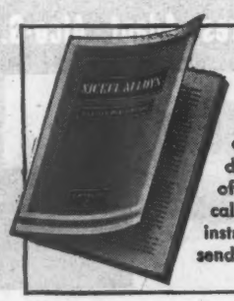
Composition and Typical Properties of Normalized Quenched and Tempered 2¾% Nickel Steel Rods

Description or Size	Melt Yield Pt. No. #s per Sq. In.	Tensile Strength #s per Sq. In.	Elong. % in 2 In.	Reduction in Area %	ANALYSIS					
					Car.	Mang.	Phos.	Sul.	Sil.	Ni
Main Rod....	92900	110000	25.0	64.4	.31	.78	.027	.026	.25	2.75
Main Rod....	86500	104500	25.5	65.6	.32	.86	.034	.032	.29	2.69
Main Rod....	86360	104400	26.0	64.8	.32	.86	.034	.032	.29	2.69
Main Rod....	87850	102350	26.0	66.2	.31	.89	.037	.025	.32	2.69
Front Rod....	86000	102250	25.0	67.3	.29	.82	.035	.027	.24	2.71
Front Rod....	83900	104250	25.0	66.1	.29	.82	.035	.027	.24	2.71
Front Rod....	86850	104250	27.0	66.1	.32	.86	.035	.025	.30	2.65
Front Rod....	89500	107050	25.5	65.6	.32	.86	.035	.025	.30	2.65
Back Rod....	89500	107650	25.0	62.7	.30	.79	.030	.025	.22	2.71
Back Rod....	87500	106450	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	87000	105600	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	88150	104850	26.0	66.8	.29	.82	.035	.027	.24	2.71

Specimens Taken from Mid-Section of Prolongations of the Forgings

The above table compiled by the American Locomotive Company shows the chemical compositions and mechanical properties of some normalized, quenched and tempered nickel steel front, main and back rods recently produced as replacement rods for locomotives being speeded up and rebalanced. These values are typical of replacement rod forgings recently tested by that company.

Quenched and tempered nickel steel forgings provide high tensile strength and ductility, combined with unusual toughness and high fatigue strength—qualities which tend to obviate breakage and assure long, trouble-free service when employed in heavy duty machinery and equipment.



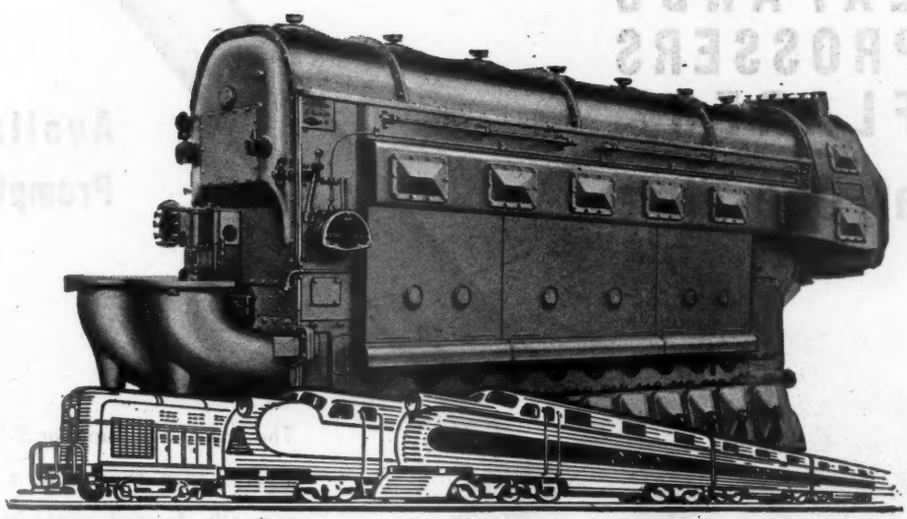
Catalog "C" makes it easy for you to get booklets and bulletins on industrial applications of Nickel, metallurgical data and working instructions. Why not send for your copy today?

★ *Nickel* ★

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall Street, New York 5, N. Y.*

Opposed-Piston DIESEL

a Major Locomotive Advantage



THE opposed-piston Diesel which powers Fairbanks-Morse Locomotives:

1. *Provides 2000 horsepower.* Thus a 6000-horsepower locomotive requires *only three Diesels.*

2. *Is simple* . . . has relatively few small parts . . . requires few adjustments . . . is quickly serviced.

3. *Is efficient* . . . uses only .37 pounds of fuel per brake-horsepower-hour.

4. *Is dependable* . . . so dependable that the U. S. Navy has specified it repeatedly for that most exacting service—powering submarines.

Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

BUY MORE WAR BONDS

A name worth remembering!

FAIRBANKS-MORSE

SUPERIOR
3-WAY FLUE ROLLER

This Tool Saves 80 per cent in Time and Labor

EXPANDS
PROSSERS
FLARES
at One Time

Available for Prompt Shipment

The use of the Superior 3-Way Flue Roller assures even expansion, a tight joint and correctly formed contours — quickly and economically.

The rolling action expands the tube in the sheet, forms a prosser on the water side and flares the end of the tube in one operation. The expansion and prossering is accomplished without scoring the tube.

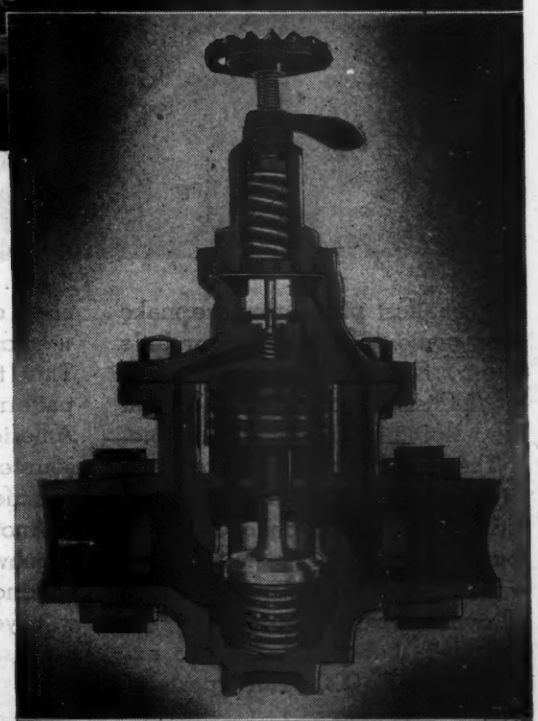
Prevents Flues From Becoming Distorted
Eliminates Fire Cracking in the Firebox End
Eliminates the Hazard of Flying Chips

SUPERIOR RAILWAY PRODUCTS CORP.
7501 Thomas Boulevard, Pittsburgh, Penna.

W. O. MARTIN	CADE-DWYER COMPANY	ROSS ANDERSON	BEN H. LOBDELL	THE HOLDEN CO.
822 So. Twenty-third Street	683 Atlantic Avenue	Stuart Court Building	539 W. Olney Avenue	736 St. James St., W.
FORT SMITH, ARK.	BOSTON, MASS.	RICHMOND, VA.	PHILADELPHIA, PA.	MONTREAL, CANADA

LESLIE REGULATING VALVES AND LESLIE-TYFON WHISTLES

Meet toughest railroad requirements!

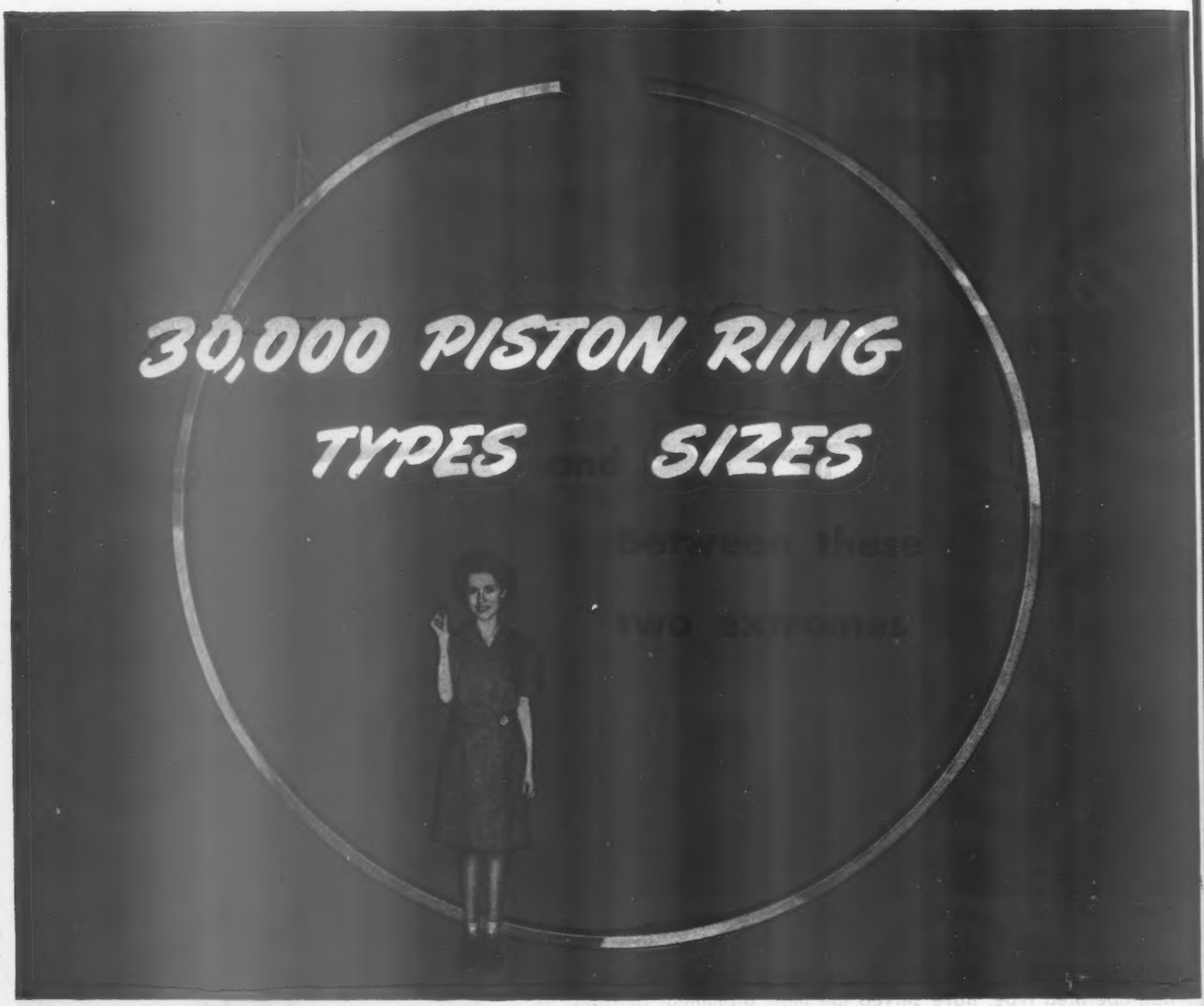


LESLIE REGULATING VALVES of the spring-loaded internal pilot, piston-operated type, have served the most prominent railroads in the country for many years. Typical railroad applications of our equipment are: heating passenger coaches with steam from the locomotive, heating cars in coach yards, train sheds and auxiliary locomotive appliances, steam-heating of offices, control towers, wash-rooms and shops, controlling steam or compressed air used in operating machinery, oil-burning equipment, etc.

UNFAILING DEPENDABILITY of Leslie Regulators, due to extremely high standards of materials, workmanship and inspection, is the primary consideration in their selection by railroad engineering officials.

LESLIE-TYFON WHISTLES are also widely used on American railroads. Their powerful, clear-cut tones and long lasting qualities, assure effective and uninterrupted performance and give them the ideal qualifications for railroad service.

LESLIE CO. • LYNDHURST NEW JERSEY



The smallest piston ring we make (you couldn't get it on your little finger) is used in the watch-like mechanism of the torpedoes that are helping to snip Japan's lifeline.

The largest piston ring we make (it's over 30 feet around) has done and is doing duty on over three-fourths of the Liberty ships whose wakes are writing V's for Victory all over the Seven Seas.

And in between these two extremes are 30,000 other types and sizes of piston rings—*for which we have patterns in our foundry.* This tremendous range of ring patterns, always available, made American Hammered a unique source of supply for the most diversified requirements.

Another important service asset is know-how . . . and that has been strikingly expanded during the war years. The PORUS-KROME* treatment that increases the life of piston rings two—three—and even four times, and the new alloy rings with double the tensile strength of any pre-war product, will let you demand more from your piston rings . . . and get it.

Rings in every size—of every type—for every purpose make this the best place to bring your ring problems. Koppers Co., Inc.—American Hammered Piston Ring Division, Baltimore 3, Md.

The first Army-Navy "E" awarded exclusively for piston ring production.

*Van Der Horst Process

Buy Extra War Bonds—and Keep Them!

HENNESSY

Mechanical Journal Lubricators

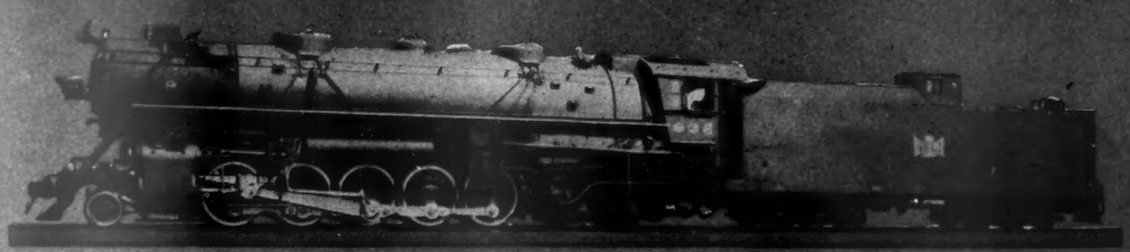
ON MANY REPEAT ORDERS

ATTEST TO THE ADAGE

"The Proof of the Pudding is in the EATING"...

HENNESSY LUBRICATOR

Weight on Drivers 274,500 lb. — Total Weight of Engine 451,000 lb.



Weight on Drivers 371,359 lb. — Total Weight of Engine 523,600 lb.

Weight on Drivers 286,900 lb. — Total Weight of Engine 479,300 lb.

Hennessy Mechanical Journal Lubricators are in use on 35 railroads in United States and Canada, as well as in numerous foreign countries.

HENNESSY LUBRICATOR CO., Inc.

75 WEST STREET NEW YORK 6, N. Y.

THIS "BIG GIRL" CAN DO THE JOB ALONE!

THIS BIG Pennsylvania passenger locomotive was designed to make the long, fast haul from Harrisburg to Chicago. Heavy trains and hills often made two locomotives necessary to maintain schedules—but this big girl can do the job alone.

NATIONAL Seamless Boiler Tubes have given excellent service under the most severe conditions. Case histories in other locomotives show that NATIONAL Seamless Tubes (Walls Without Welds) have lasted 1½ to 2 times as long as the type of tubes used before.

Where cinder cutting is severe, NATIONAL seamless heavy ended tubes have proved to be the answer to this troublesome problem. The thicker metal at the firebox end gives longer life, cuts down replacements and allows more miles on the rails.

On retubing jobs, the easy workability of NATIONAL Seamless boiler tubes saves hours of time and gets locomotives back in service that much quicker. Considerable less splitting waste is encountered at end of NATIONAL tubes during rattling operations.

All NATIONAL Seamless Boiler Tubes are made from completely killed, i.e., thoroughly deoxidized steel and therefore have better creep properties at high temperatures, while the uniform density, freedom from laminations and sound metal structure of deoxidized steel provides superior heat transfer characteristics. Every tube is completely annealed. We will be glad to send you our bulletin.

Retubing three hours quicker is a common experience when NATIONAL Seamless Boiler Tubes are used.

WALLS WITHOUT WELDS

NATIONAL TUBE COMPANY

Pittsburgh, Pa.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

USS

UNITED STATES STEEL

SERVING THE *Petroleum Needs of the Nation*

Typical Sinclair Refinery, Transportation and Distribution Units.

SINCLAIR produces oil from more than 8000 wells located in the United States and Venezuela.

MANUFACTURES all types of petroleum products in 10 modern refineries processing 90,000,000 barrels of crude oil annually.

DISTRIBUTES petroleum products through 2000 wholesale bulk plants which also service a network of many thousands of Sinclair Dealer stations.

PRODUCES basic material for manufacture of synthetic rubber in one of the largest butadiene plants in the United States.

PRODUCES highly specialized lubricants and fuels which are used by more than 150 American Railroads.

Sinclair is America's outstanding manufacturer of lubricants.

SINCLAIR RAILROAD LUBRICANTS

SINCLAIR REFINING COMPANY, *RAILWAY SALES*, NEW YORK • CHICAGO • SAINT LOUIS • HOUSTON

FOR SAVING WEIGHT WITHOUT LOSS OF STRENGTH

—No Other Material Can Equal ALLOY STEELS

Cut weight and you increase the potential for speed, for greater payload and for reduction in haulage power needed. Cut weight and you increase the potential for profits, too.

As a means for saving weight in equipment of every type, *without loss of strength,* no other material can equal alloy steels.

Alloy steels provide highest strength-to-weight ratios—hence, they may be used safely in smaller sections to reduce weight or to reduce area of parts or equipment.

They possess highest degrees of hardness—and thus provide the resistance to wear essential to long service life, and low maintenance cost in moving parts.

Alloy steels are exceptionally tough, too. They resist severe shocks and concentration of stresses. And they also resist corrosion, fatigue, heat and cold.

Republic—world's leader in the production of alloy steels—is ready to offer you its unequalled experience in obtaining the maximum benefits from these fine steels. Name the date and we'll gladly send a metallurgist to talk to you.

REPUBLIC STEEL CORPORATION

Alloy Steel Division • Massillon, Ohio

GENERAL OFFICES • CLEVELAND 1, OHIO

Berger Manufacturing Division • Culvert Division
Niles Steel Products Division • Steel and Tubes Division
Union Drawn Steel Division • Truscon Steel Company
Export Department: Chrysler Building, New York 17, N. Y.

Republic

ALLOY STEELS

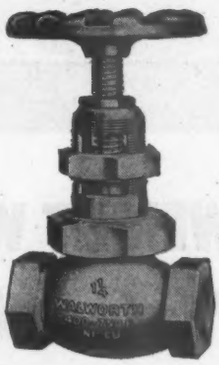
Also Carbon and Stainless Steels—Sheets

How 6 ENEMIES of METALS are being defeated in typical uses by Inco Nickel Alloys

ABRASIVE SCALE particles hammer at the seats of blow-off valves . . . corrosive and erosive hot waters add their destructive force. Yet the *first* Monel trim on a T.Z. valve used by the New Haven was still in service after 12 years! A recent count showed 272 of 331 New Haven locomotives equipped with Monel-trimmed T.Z. valves. A New Haven executive writes "...The Monel seats have given very satisfactory service . . . very few have been renewed . . ." ***INCO Nickel alloys defeat abrasion.***

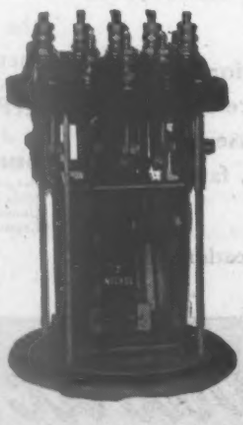
EROSIVE STEAM, direct from the locomotive boiler, blasts with full force at the inner cylinders of steam separators, often causing failure in as little as 3 months. Over 4 years ago, the Dri-Steam Products Co. fabricated a new-type separator of Monel. Since then, with more than 300 in service, not one Monel separator has failed! In addition to long life, the Monel separator costs 30% less . . . weighs only half as much as separators made of the metal formerly used. ***INCO Nickel alloys defeat erosion.***

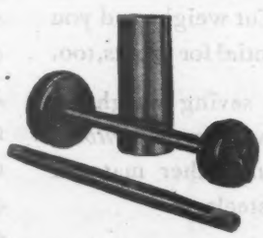
CORROSIVE WATERS cannot harm the fine (.006") wires that form the Knit Metal Mesh feedwater filters used by the Vermont Central R. R. The 14" x 20" pads provide 15,000 square inches of filtering surface with a million meshes to snare dirt, scale and oil from the feedwater. They are easily cleaned with steam or any ordinary solvent . . . resist breakage and corrosion because they are knit of strong, tough, corrosion-resistant MONEL. ***INCO Nickel alloys defeat corrosion.***



TEMPERATURES TO 750°F....more than 200°F. beyond the limit usually considered reasonable for bronze valves . . . and pressures to 400 psi. had to be handled by valves in Burlington Engine No. 3012, built in 1935. Walworth built valves with all-Monel bodies were installed. Now, after more than 1,150,000 miles of service, the majority of the original Monel valves are still at work. Burlington states: "Monel valves are one of the few foolproof parts of a locomotive." ***INCO Nickel alloys defeat high temperatures.***

FATIGUE . . . 100,000,000 flexings a year must be withstood by the spring pendulum used in the Code Transmitter built by the Union Switch and Signal Company. The transmitter, operating directly through track rails to wayside signal, engine cab signal, or both, shows traffic conditions on the trackage under its control. The spring which vibrates as much as 100,000,000 times a year is made of fatigue-resistant "Z" Nickel. In years of service, not one "Z" Nickel transmitter spring has worn out. ***INCO Nickel alloys defeat fatigue.***





HEAVY STRESSES, corrosive gases and abrasive grit gang up on locomotive boiler feed pumps. Sending 110 to 200 gallons of water into the boiler at a rate of 74 to 80 strokes per minute, the pump must withstand heavy stresses. The rods are exposed to grit, sleet and corrosive gases. Linings must retain a smooth highly polished surface. Since 1922, Worthington Pump & Machinery Co. has been making vital parts of these pumps from Monel. ***INCO Nickel alloys defeat heavy stresses.***

NICKEL (INCO) ALLOYS

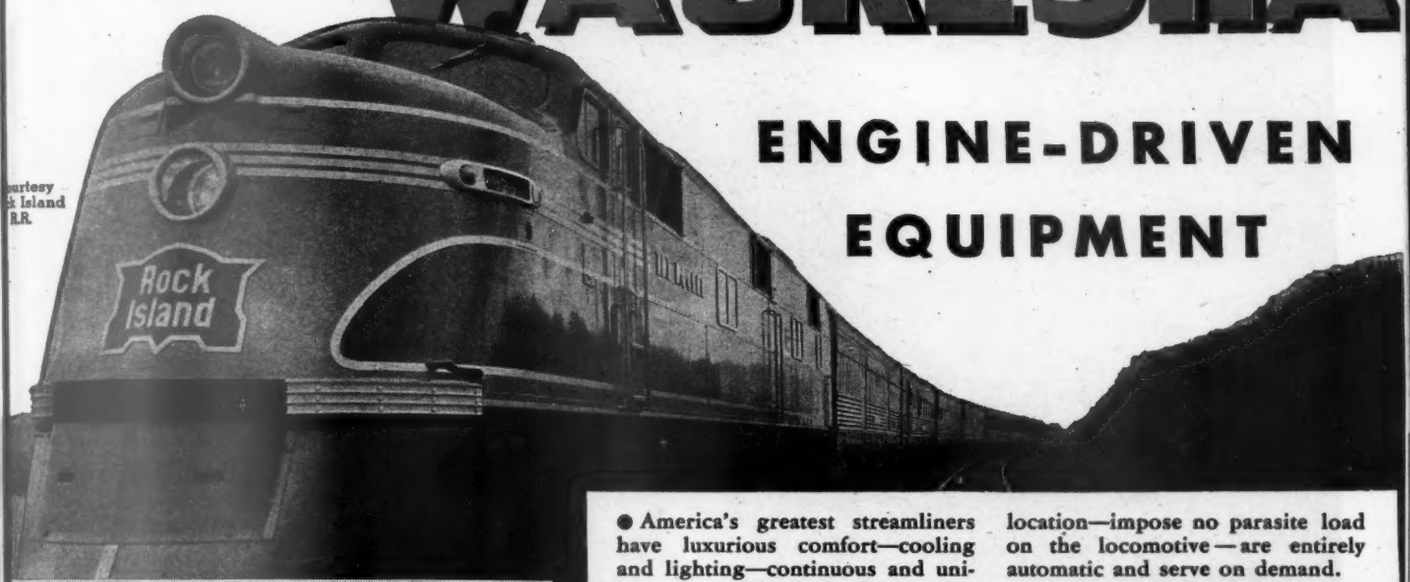
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N.Y.

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings . . . Welding Rods (Gas & Electric)

Over half the Streamliners use

WAUKESHA

ENGINE-DRIVEN EQUIPMENT

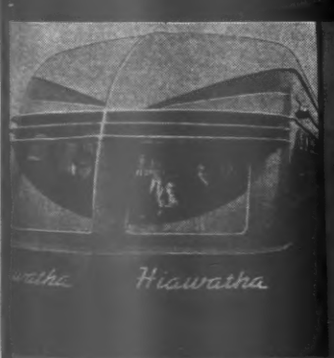


● America's greatest streamliners have luxurious comfort—cooling and lighting—continuous and uniform — supplied by Waukesha Engine-Driven Air Conditioning and Generator Units.

Stepped-up operating schedules and super-comfort have captured the cream of America's passenger traffic for these great trains. Waukesha, light, economical, dependable, engine-driven units make an important contribution to this operation.

They are independent of train movement, weather conditions or location—impose no parasite load on the locomotive — are entirely automatic and serve on demand.

Nearly a decade of outstanding service, with millions of miles of operation, have *tested* and *proved* this Waukesha equipment. The experience and recommendations of railway men directly concerned with its operation and maintenance have resulted in *added refinements and improvements.* As soon as manufacturing authority is granted, this equipment will be in production and available for your requirements. Write us today.



REFRIGERATION DIVISION

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN

Largest Builders of mobile, engine-driven Refrigeration and Generator Equipment

It's what goes on INSIDE that counts

"Comparator" greatly magnifies ring ends to make possible precision-check of all angles

Inside an engine, little things make a big difference

TAKE piston rings of identical design. Variances in width, thickness, diameter, flatness, or circularity, may be so little that they cannot be detected by the naked eye. Yet, inside an engine, these little things can affect performance as much as 50 per cent or more.

Pedrick *precisioneered* piston rings deliver full power for longer life because they are precise in every way. Precision of dimensions and characteristics is assured by special manufacturing processes, developed through long years of experience . . . and by constant checking by our carefully trained laboratory technicians.

In locomotive air pumps, motor-driven air compressors, maintenance-of-ways equipment, auxiliary locomotive equipment, mechanical stokers, and all types of Diesel, gas and oil engines, you'll find Pedrick *precisioneered* piston rings giving extra-long, trouble-free service.

WILKENING MANUFACTURING Co., Philadelphia 42, Pa. *In Canada:* Wilkening Manufacturing Co. (Canada) Ltd., Toronto.

Pedrick

precisioneered PISTON RINGS

America's No. 1 Christmas Gift — A WAR BOND

TYPICAL DIESEL LUBRICATION PROBLEMS:

5. Liner Wear

Wear on Diesel liners is commonly concentrated in the high-temperature belt near the combustion chamber. This is largely attributable to the inherent inability of most lubricating oils to "wet" hot metal surfaces.

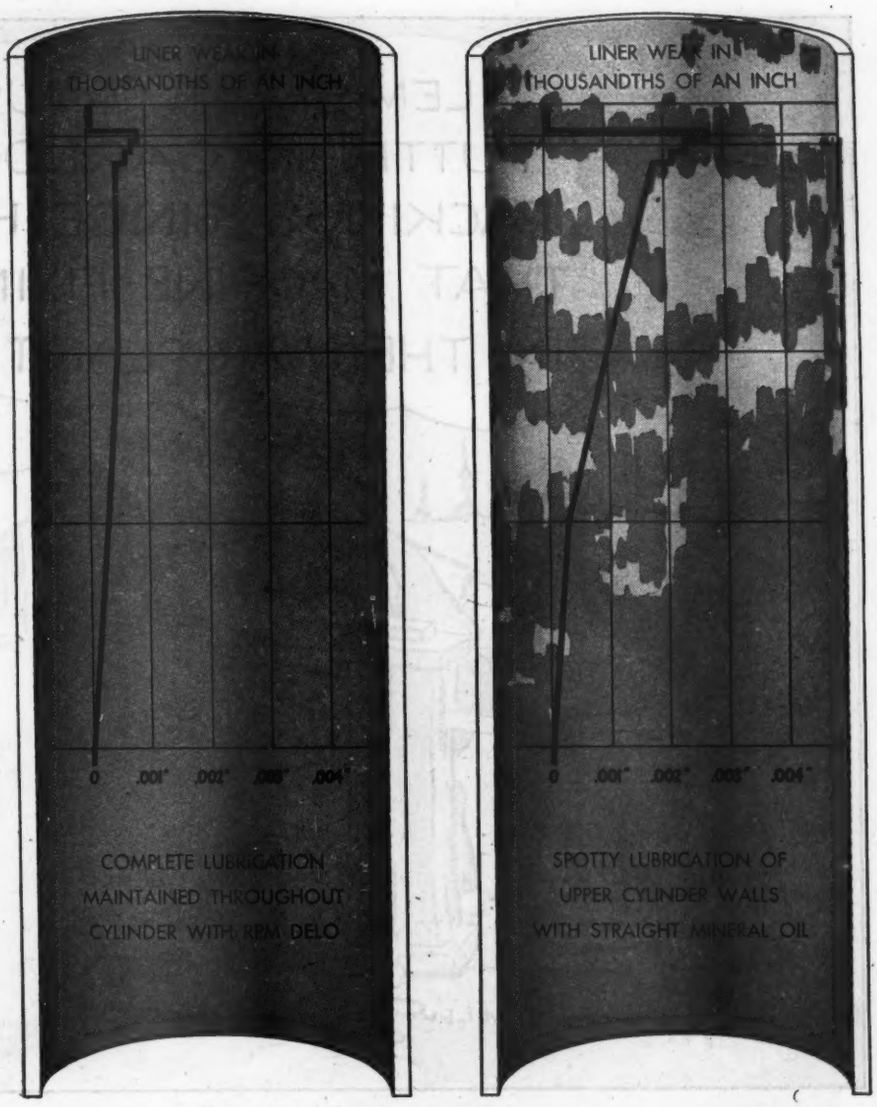
Unlike spark ignition engines in which a partial vacuum in the combustion space during the intake stroke assists in drawing oil toward the upper compression rings, Diesels operate at or above atmospheric pressure in the combustion space which tends to drive oil away from the rings.

It is imperative then—to prevent relatively dry operation in the top piston ring high-temperature area—for the lubricant to have high-temperature adhesion characteristics.

To achieve this high adhesion factor under all operating conditions in RPM DELO Diesel Engine Lubricating Oil, a special compounding material was added. With this additive, RPM DELO will not run away from hot surfaces, thus preventing metal-to-metal contact on hot-running engine parts.

A typical example of the effectiveness of RPM DELO in preventing liner wear is offered by the Chicago, Rock Island and Pacific Railroad. One of its "Rocket"

Liner from Rock Island "Rocket" engine showing wear of only .001 in. after 157,076 miles on RPM DELO without an oil change.



These charts of one of the tests required by the Army in certifying oil for use in combat equipment, graphically illustrate (right) marked increase of liner wear in upper cylinder zone due to inability of straight mineral oil to provide full lubrication of this high-temperature area; and (left) reduction of liner wear by ability of RPM DELO to stick to these hot spots.

Diesel powered locomotives ran 157,076 miles on RPM DELO without an oil change, with liner wear of only .001 in.

Other causes of liner wear minimized by RPM DELO include:

1. Corrosion caused by carbonic and other acids at low temperatures.
2. Scuffing of liners from rocking of piston rings in worn grooves.
3. Scoring and scratching of liners due to stuck piston rings.

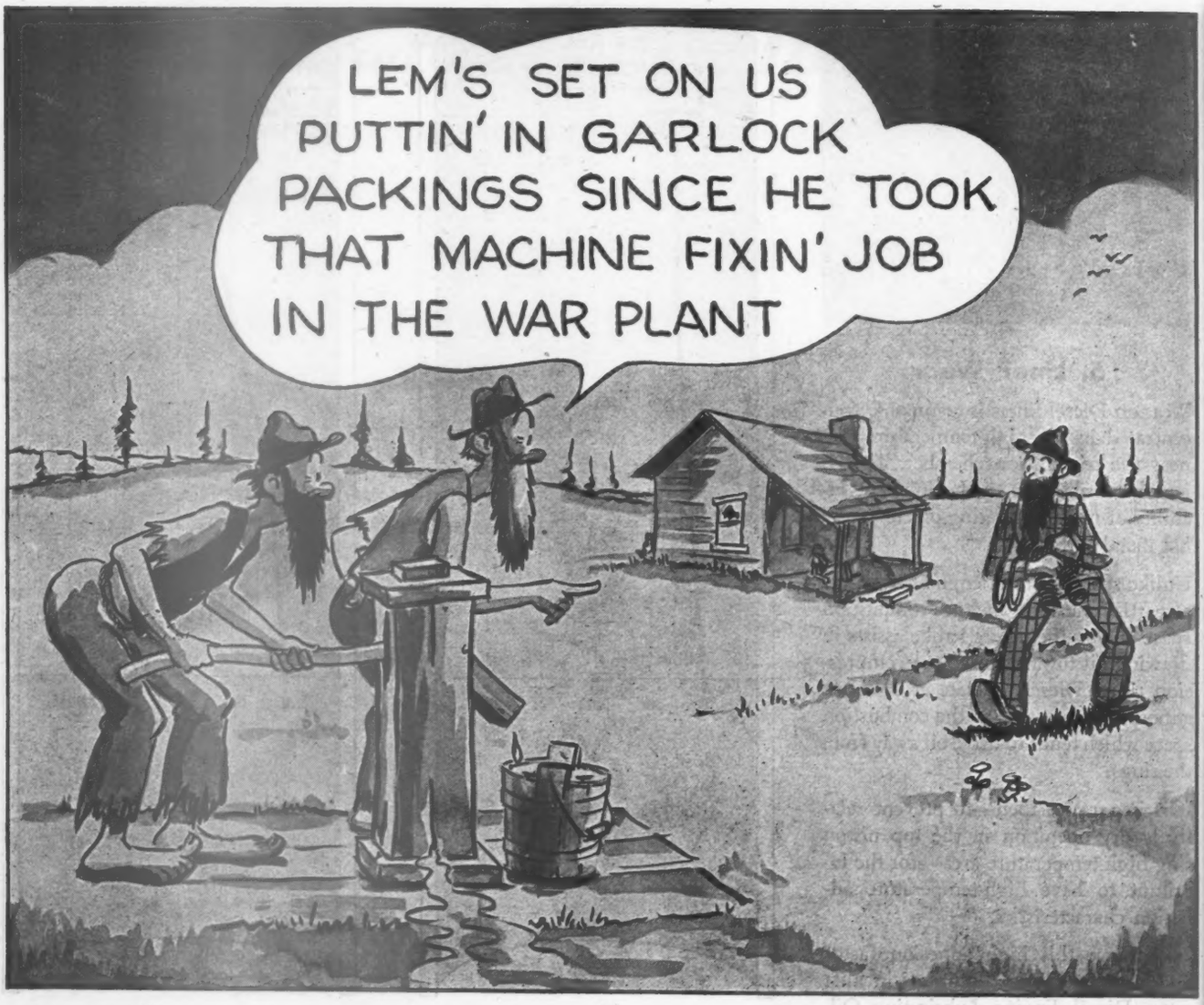
Reducing liner wear to a remarkable degree is but one of RPM DELO'S advantages in solving Diesel engine maintenance problems. Its other properties include: The ability of RPM DELO to eliminate ring sticking, to stop excessive deposits on rings and ports, and to prevent bearing corrosion.

RPM DELO has world-wide distribution and is marketed under the following names: RPM DELO, Caltex RPM DELO, Kyso RPM DELO, Signal RPM DELO, Sohio RPM DELO, and Imperial RPM DELO (concentrate). Ask your Diesel engine manufacturer or distributor for the RPM DELO supplier in your vicinity.

RPM DELO

Write on your letterhead for free booklet on RPM DELO, *Standard of California, Dept. T-12, San Francisco, California*

STANDARD OF CALIFORNIA



Speaking of Water Pump Packing . . .

Have You Tried GARLOCK 777?

This popular packing is recommended for hot or cold water service; for steam service on piston and valve rods of engines, and for steam piston rods of low pressure pumps. Quality-controlled construction assures dependable performance.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Quebec

Garlock

CARS WILL BE AS COMFORTABLE *INSIDE* AS PIPES ARE WELL INSULATED *OUTSIDE*

Insutape and Wovenstone help keep passengers satisfied by protecting pipes from the ravages of weather, thus assuring a continuous supply of steam for comfortable coach and car interior temperatures. This will be an important factor in providing the type of travel that will attract passengers. Because Insutape and Wovenstone aid in providing a warm, comfortable trip— it is the standard insulation on a majority of the nation's railroads.

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

310 S. MICHIGAN AVE., CHICAGO 4, ILL.

NO SPRING PLATES
NO SPRING PLANKS

FOR TRAIN SPEEDS THAT Soar

Ride-Control COSTS NO MORE!

The A.S.F. Ride-Control Truck (A-3) makes possible material increases in freight-train speeds when used with long-travel, easy-riding coil springs. Thus, the cars under which it is used can carry more revenue tonnage in any given period. And increased speeds that provide faster overall schedules and service at lower unit cost are the measure of true operating economy.

Protection of lading and reduction of car maintenance and roadbed wear are additional factors that make this truck a sound choice from an operating economy standpoint.

While the Ride-Control Truck is safe for high-speed operation, it is in the price and weight range of conventional freight-car trucks.

To meet today's needs a

Almost 5 tons lighter — but stronger

This COR-TEN, 50-ton all-welded box car, designed and built by Pullman-Standard, will carry over 4½ tons more payload, yet costs no more.

The Division of Engineering Research, A.A.R. conducted impact tests on this car to compare its strength with that of the A.A.R. standard box car, at impact speeds up to 13.3 m.p.h.

Report states: "No defects were detected in the Pullman box car — the stress, in proportion to the yield point of the material, was in general much lower in the Pullman box car than in the A.A.R. car, at practically all speeds of impact."

6,000 COR-TEN hopper cars each weigh 10,000 lb. less

These big capacity, hard-working 70 and 90-ton hoppers can carry 5 tons more payload, and do. Their condition after six years of hard service indicates that they will last as long as heavier copper-steel construction before needing heavy repairs. Built by Pullman-Standard, American Car and Foundry, General American and Pressed Steel Car Co.

Designed to exceed all A.A.R. strength requirements yet weighs 8,500 lb. less

Designed and built by the General American Transportation Corporation, this all-fusion welded 50-ton box car weighs 36,800 lb. Roof, sides, ends, doors and underframe, with the exception of center sill, are of U-S-S COR-TEN. An unusually flexible design readily adaptable to varying requirements

s and tomorrow's competition

— *build freight cars lighter with* U·S·S COR-TEN!

NO alert railroad man needs to be told he is facing a period of postwar competition from other freight transportation media that makes changes in present freight car construction not only desirable but imperative.

That these necessary changes primarily involve the reduction of deadweight—that in lightweight construction with its attendant increase in payload capacity, and reduced operating and maintenance costs the railroads must seek an answer to future competition—any railroad man with his ear to the ground must agree. The facts are too plain to ignore.

For only with *lighter* cars—cars that will carry more payload, that will reduce train tonnage, that permit reduction in number of locomotives, and that will mean less expense for maintenance of both equipment and roadway—is it possible to effect the economies that will permit maintenance of streamlined freight schedules and more frequent and faster service that will attract shippers from other competing forms of transportation after the war.

Now with COR-TEN again becoming available, your new freight equipment can be built light, with little or no increase in cost, to assure you not only top efficiency for today's operations, but to give you worthwhile economic advantages in the tough competition that the end of the war will surely bring.

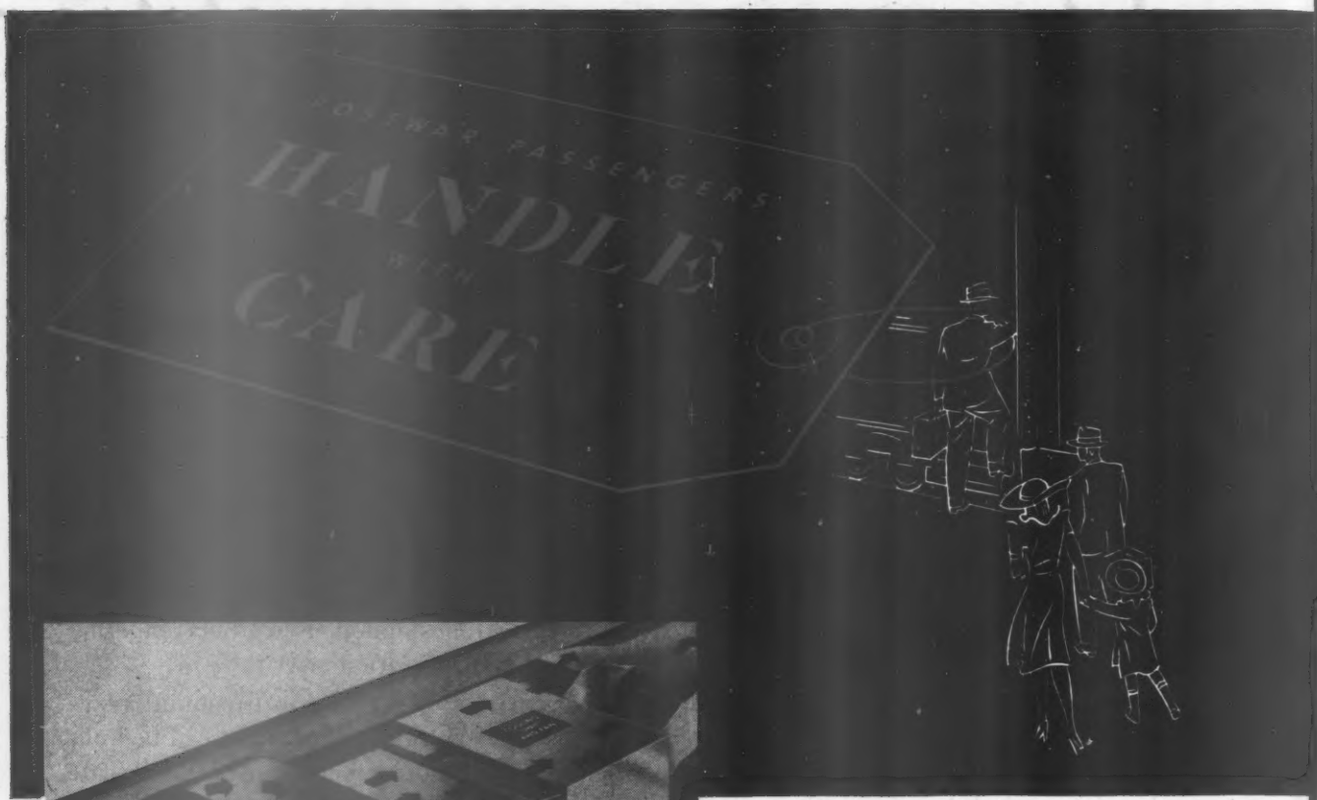
AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York* · **CARNEGIE-ILLINOIS STEEL CORPORATION**, *Pittsburgh and Chicago* · **COLUMBIA STEEL COMPANY**, *San Francisco* · **NATIONAL TUBE COMPANY**, *Pittsburgh* · **TENNESSEE COAL, IRON & RAILROAD COMPANY**, *Birmingham* . United States Steel Export Company, New York

500 box cars each built 7,600 lb. lighter

Built by the Mt. Vernon Car Manufacturing Company, these modern automobile cars, 50'6" long, have a lightweight of 55,000 lb. U·S·S High Strength Steels were used in side structural members and side sheathing.

USS

UNITED STATES STEEL



Strenuous competition in transportation mean postwar passengers must be handled with car . . . delivered swiftly, safely *and without a accumulated coating of smoke, dust an cinders.*

This can be done easily by electronically cleaning air in passenger cars with Precipitron This new principle is so efficient it removes mor than 90% of the dirt, smoke and grime in the ai even particles as small as 1/250,000 of an inch Precipitron can be installed readily in the ai conditioning system of any car, and it is designe particularly for easy and infrequent cleaning.

Precipitron offers an extra benefit in the pos war scramble for passengers . . . complete fre dom from travel dirt. Your nearest Westinghous office will be glad to send you a new book B-3420, with complete information on Precipitro for passenger cars. Or write Westinghous Electric & Manufacturing Company, P. O. Bo 868, Pittsburgh 30, Pennsylvania. J-94

*Trade mark registered in U.S.A.

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWH

Precipitron

THE ELECTRONIC AIR CLEANE

Train Talk

NEWS AND VIEWS ON ELECTRICAL EQUIPMENT
FOR TRAIN, TRACK AND TERMINAL

The Burlington Railroad Streamliner, General Pershing, traveling between St. Louis and Kansas City in April 1939, was the first passenger train to be equipped throughout with fluorescent lighting. With the advent of the modern streamlined train, quality of lighting was greatly improved . . . attractive fixtures eliminate glare and increased electric power supply automatically increases luminous intensity.

Fluorescent lighting, water coolers, air cleaning and power supply are reviewed in a recent prospectus featuring "Development of Electrical Equipment for Standard Railroad Passenger Cars". Separate specifications are also available for the convenience of railroad executives, designers, engineers and car builders, in planning the passenger car of tomorrow—today.

Postwar railroad travel will be greatly stimulated by modernization of station facilities. Feeder traffic will be more quickly handled, parking facilities more convenient, waiting rooms will be more attractive and comfortable. If you are contemplating redesign or expansion of station, terminal, repair shop, warehouse or office, you will want a copy of the "Planning Guide" (B-3350).

Improve the quality of welding and the efficiency of the welder through education. "Causes and Cures of 14 Common Welding Problems" is the title of a 24-page pocket-size booklet (B-3326) and a popular wall chart (DC-250). Good tips on safety are fully explained in "Safety in Gas and Electric Welding" (B-3458). All three are yours for the asking.

Designers and engineers interested in postwar building and conversion are invited to make full use of Westinghouse Transportation Engineering facilities and service . . to keep abreast of the latest improvements and developments of electrical equipment. For more information or descriptive product literature, call your nearest Westinghouse office. Or write to Westinghouse Electric & Manufacturing Co., P. O. Box 868 Pittsburgh 30, Pa.

Westinghouse ELECTRICAL EQUIPMENT FOR TRAIN, TRACK, TERMINAL

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

Brake Shoes should be worn to

Get full service from your brake shoes. Do not remove them until they are worn to the limit-of-wear mark. To take them off sooner is a waste of material and time.

The limit-of-wear is clearly visible. Be sure to wear to this mark.

Do not remove partially worn brake shoes. This shoe has many miles of service that are being thrown away.

Wear all Brake Shoes to the Li

rn to the *Limit...*

Do not remove cracked shoes until they have been worn to the limit-of-wear mark. The steel back holds the wearable metal in its place for full-wear duty.

HERE IS THE WAY A COMPLETELY WORN SHOE SHOULD LOOK. It has been worn to the limit-of-wear mark. No material or labor has been wasted.

Watch your brake shoe scrap pile for partially worn brake shoes. If you find any, return them to service. Instruct all concerned to avoid this wastage.

AMERICAN
Brake Shoe
COMPANY

BRAKE SHOE AND CASTINGS DIVISION
230 Park Avenue, New York 17, N. Y.

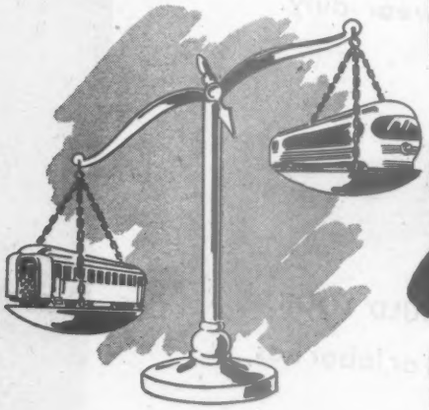
Limit-of-Wear **mark**

3783

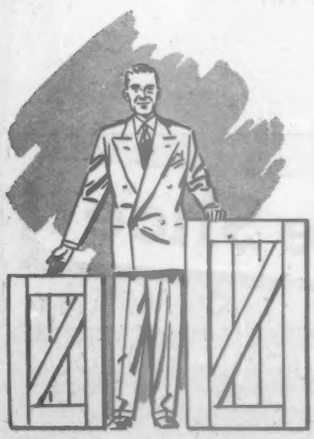
IT'S DESIGNED AND WAITING FOR YOUR NEW CARS

Improved STURTEVANT

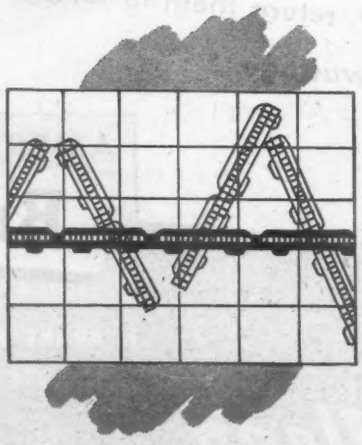
IT'S LIGHTER



IT'S SMALLER



IT DELIVERS LEVEL COMFORT



IT'S EASY TO MAINTAIN

B. F. STURTEVANT COMPANY · HYDE PARK, BOSTON 36, MASS.

AIR CONDITIONING

Sturtevant engineering skill has kept pace with your own plans for new passenger cars . . . designing further refinements into air conditioning equipment that put you nearer to tomorrow's practical goals of light, speedy, comfortable, economically-operated cars. Ready for you now are Sturtevant equipment and systems that lengthen the comfort zones . . . trim tonnage of streamliners . . . fit into finicky spaces . . . cut inspection and maintenance time. These few details will illustrate:—

Lighter Equipment — The new Sturtevant Compressor-Condenser unit, for example, tips the scale at less than 1900 pounds. The compressor itself weighs under 300 pounds—including the flywheel! Weight of the new Fan-Evaporator — complete — totals less than 550 pounds. Also in this lightweight class are Sturtevant's new dry surface Condenser Unit and the Evaporative Condenser using spray water.

No need to tell you how these savings step up the proportion of pay load hauled.

Smaller Units — Sturtevant has trimmed its units down to fighting size—to fit into the snug spaces allotted to auxiliary equipment in tomorrow's cars. For instance a complete 7-ton capacity Compressor-Condenser unit measures only 25″ x 84″ x 40″—and a similarly rated Fan-Evaporator unit tapes only 20″ x 44″ x 52″.

Yes, they're small—but without sacrificing cooling efficiency. Blower fans supply enough air for the average coach—2400 c.f.m. at 1⅛″ s.p.—using a single 1 h.p. motor! And in lounge cars and diners, ½ and ¾ h.p. motors are adequate. Compressor efficiency, too, has been stepped up—cutting horse-power costs per ton of refrigeration.

Easy Maintenance — Tomorrow's schedules, calling for longer runs and less time off-the-road, will cut deeply into available maintenance time. Typical of our planning along these lines is the Sturtevant Compressor-Condenser, in which maintenance and inspection are shortened 2 ways:—

First, the compressor doesn't cycle 10 to 12 times an hour, but operates *continuously.* Wear on equipment due to frequent starting and stopping is eliminated.

Second, valves, gauges, in fact all parts of the compressor have been positioned within easy reach. Parts that need attention get it in a hurry. The entire compressor can be taken down quickly and put together easily with ordinary tools—no special tools or fixtures are needed.

Comfort That Stays Put — There's no place in tomorrow's cars for air conditioning that cycles between "too hot" and "too clammy"! That's why you'll want to plan on flattening such fluctuations in temperature and humidity with the new Sturtevant system that synchronizes equipment operation. Unloading valves cut *one half* of the compressor cylinders in or out, depending on refrigeration demands, while the divided Fan-Evaporator cuts its output correspondingly. This leaves some coils always operative—forestalling re-evaporation of the moisture and consequent flutters in humidity.

Actually, this system delivers full cooling capacity when the temperature rises above "ideal" . . . and exerts a holding action when temperature and humidity are within the comfort zone.

WE'LL WORK WITH YOU NOW

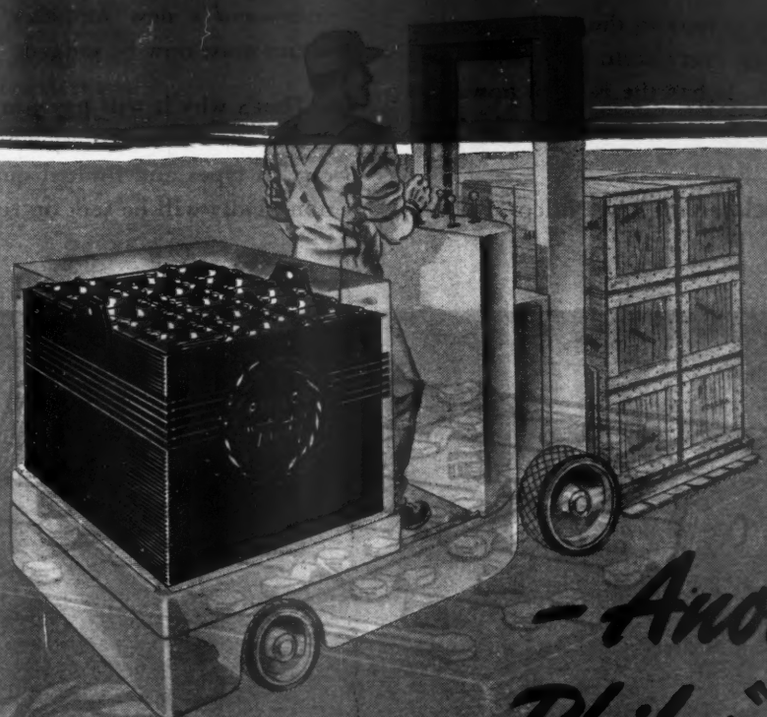
Any type of car you are planning now can benefit by the reduced size, weight and maintenance . . . the stepped-up efficiency of a new Sturtevant system. That's why it will pay you to get in touch with us. We may be able to help you streamline your planning now—and save time and money later on. Whatever your needs—pressure ventilation, complete ice or mechanical air conditioning—a Sturtevant Engineer is on call to help you to "put air to work", using tomorrow's methods and equipment.

Sturtevant
REG. U. S. PAT. OFF.
Puts Air to Work

PHILCO

Again in the News

THE BATTERY THAT GIVES 30% LONGER LIFE



–Another Philco "First"

Revolutionary new

PHILCO "THIRTY"

WITH 30% LONGER LIFE RADICALLY CUTS MOTIVE POWER BATTERY COST!

★ ***Reduces depreciation and maintenance***
★ ***Gets more work done***
★ ***Packs a terrific wallop***

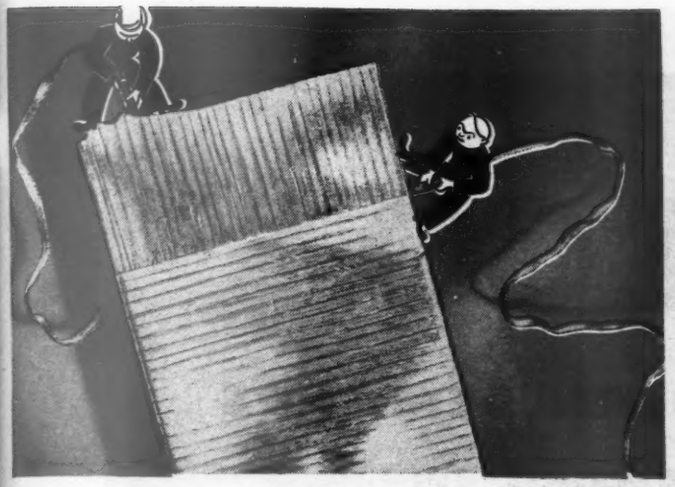
What every materials handling man wants in a storage battery is **packed** into this amazing new Philco "Thirty."

In high capacity, it is **tops** in the field—assuring the maximum tonnage every shift. Even after long hours of heavy work, it has the reserve power to climb ramps and grades, and complete the shift in *high*.

But the feature which sets the new Philco "Thirty" entirely apart from all other batteries you have known, used, or even heard of before—is its phenomenal long life. **30% longer life**—often more—has been demonstrated time after time in exhaustive field tests.

Here, then, is more than just a new and better battery. Here is a new standard of battery performance—*and* a new yardstick by which all battery values must now be judged.

That's why it will pay you to get posted on this great new Philco Battery which is now available in certain types and limited quantities. Full information gladly will be sent on request.

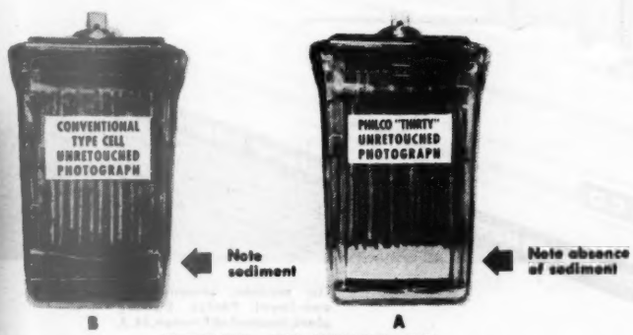


REVOLUTIONARY NEW PRINCIPLE OF PHILCO FABRICATED INSULATION*

Only PHILCO "THIRTY" has it!

Here is a brand-new construction principle *and* an ultra-modern application of a proven insulating material. Both the results of Philco pioneering! This material is fabricated glass tape wrapped around the positive plates in two layers, first vertically and then horizontally. Even a single layer of this glass tape insulation has been found to have better retentive power in holding the active material in the plate, than the standard glass mat! And—of course, the plates of the Philco "Thirty" are further protected and insulated with the time tested Philco slotted rubber retainer and rubber separator. **Patent applied for*

YOU GET IT FIRST WITH PHILCO



PROVED BY YEARS OF FIELD AND LABORATORY TESTS

As proved in scores of service tests, these unretouched photographs show what happens when a Philco "Thirty" cell (A) and a conventional type cell (B) are tested side by side in motive power cycle service, charged and discharged in series in the same circuit. Glass jars were used here only to permit observation. Note almost total absence of sediment in the Philco "Thirty", while the sediment space of cell B is filled. Cell B has delivered its normal life expectancy and is worn out—while the Philco "Thirty" still delivers over 100% of rated capacity, with a long margin of serviceable life still to go.

THE CLIMAX OF 50 YEARS OF LEADERSHIP IN BATTERY RESEARCH AND ENGINEERING

The procession of Philco "Firsts", covering the whole field of motive power and stationary batteries, has set the pace in modern battery design. Check the developments, which have contributed most to today's higher capacities, increased efficiency, longer life, and lower cost—the record shows *you get it first with Philco.*

PHILCO VITRABLOC

A development for telephone, control and standby service, that materially increases battery room capacities.

PHILCO FLOTÉ

The battery that exerted a major influence on the wider use of full float service, by eliminating low cells. More efficient . . . more economical to maintain.

PHILCO HIGH CAPACITY CELLS

Through modern plate design, Philco showed the way to increased capacity without increase in over-all battery dimensions. A tremendous advantage in many motive power operations.

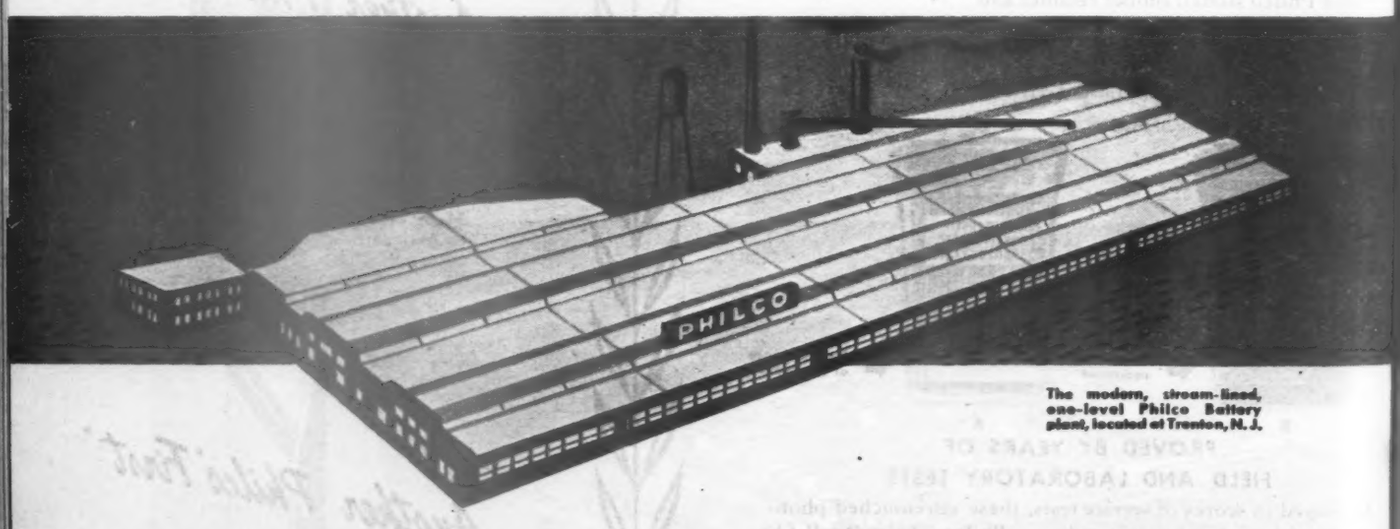
PHILCO

BUILT FOR MODERN DEMANDS BY THE LEADER IN MODERN BATTERY ENGINEERING

As described in the foregoing pages, Philco is ready, today, with the advanced battery performance and long-life economy you'll need in your post-war operations. With model manufacturing facilities, Philco is ready to produce these superior batteries in greater volume than ever before.

In the complete Philco line are modern storage batteries for all industrial applications—industrial trucks, mine locomotives and shuttle cars, diesel starting, railroad car lighting and air conditioning, control and power, telephone service and signal systems.

On your next purchase of batteries specify a modern Philco.



The modern, stream-lined, one-level Philco Battery plant, located at Trenton, N. J.

PHILCO CORPORATION

STORAGE BATTERY DIVISION • TRENTON 7, NEW JERSEY

For 50 Years a Leader in Industrial Storage Battery Development

This needn't happen to you

use PRESSURE-TREATED WOOD

It's too bad that this car had to be taken out of revenue service for repairs due to preventable decay, particularly at a time when shop labor and materials are so scarce. Pressure-treatment would have kept this deck on the job for years to come.

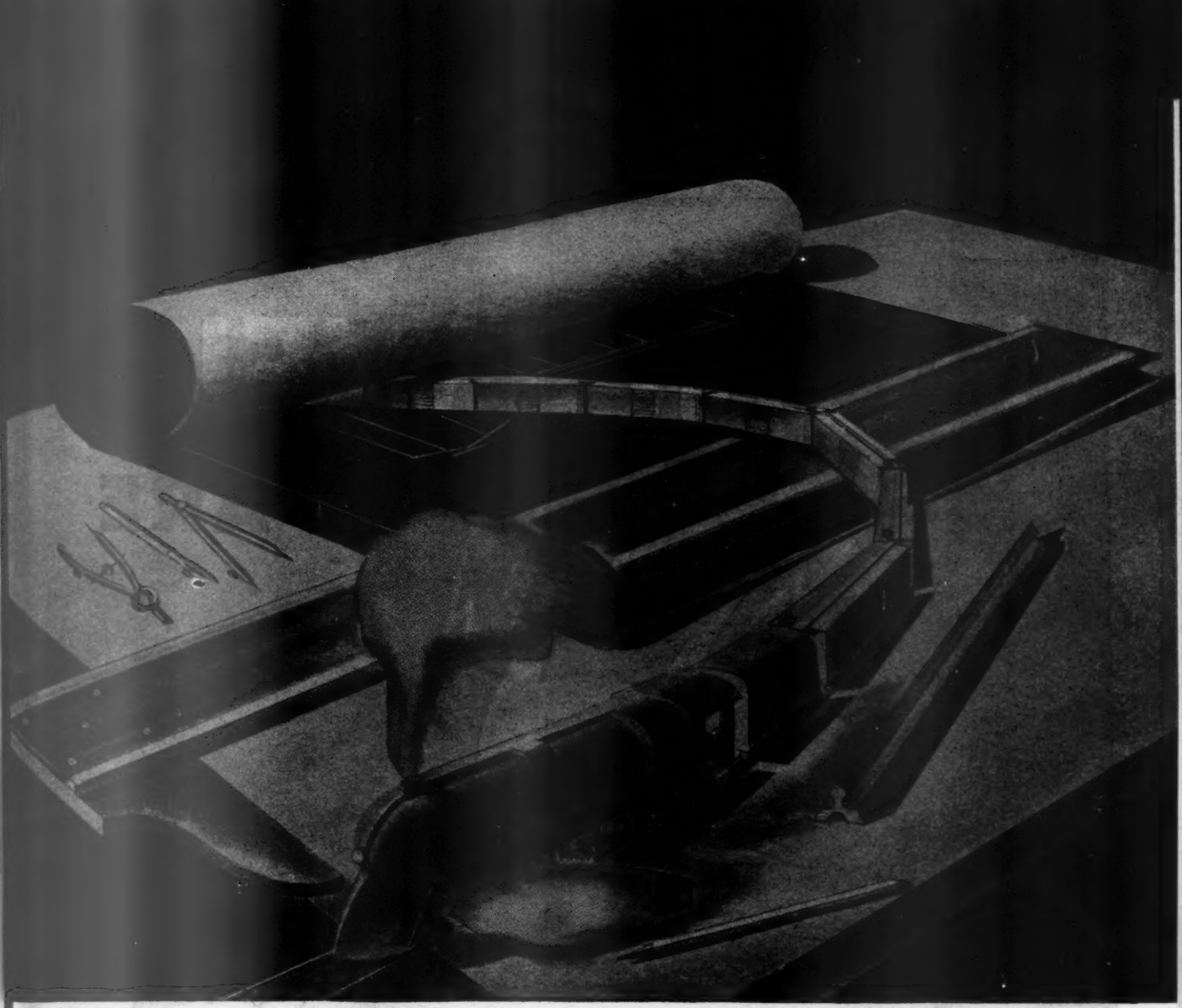
There's no guess-work about the extra service given by pressure-treated car lumber. One Railroad's experience showed that pressure-treated decking gave an average life of three times that of untreated decking.

Our bulletin, "Pressure-treated lumber for Railroad Cars," condensed for quick reading, should be of interest to you. It also gives a digest of the treating specification practice of a number of railroad users. Ask for a copy.

KOPPERS COMPANY, INC., • WOOD PRESERVING DIVISION
PITTSBURGH 19, PA.

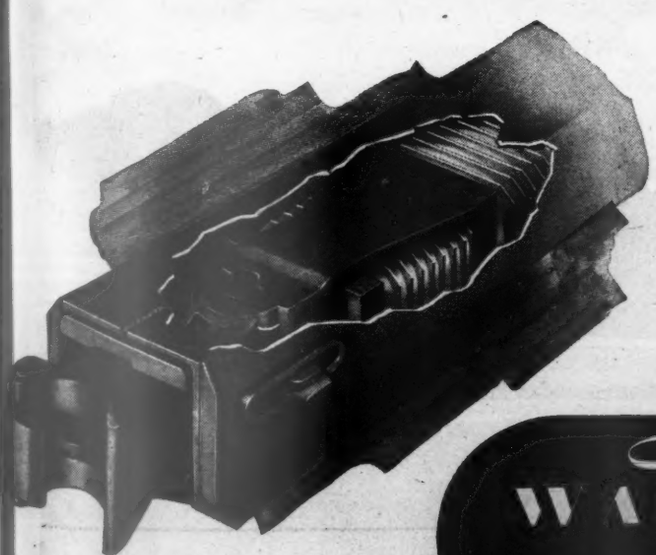
KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY



Here it comes...

THE HIGH-SPEED FREIGHT



New speeds will set new problems . . . will necessitate the use of new equipment to assure safety and to provide protection for lading and rolling stock. These fast freights will require cushioning that has no solid point . . . double action cushioning that allows no free slack in either direction . . . the protection afforded by Waughmat Twin Cushions.

Waughmats take the bite out of impact; eliminate most end shocks and in consequence reduce the force and frequency of the component vertical and lateral shocks as well. Here, in Waughmat Twin Cushions, is the proven cushioning device for tomorrow's high speeds.

WAUGHMAT *Twin Cushions*

Waugh Equipment Company, New York, Chicago, St. Louis • *Canadian Waugh Equipment Company, Montreal*

Electrons

FOR THE TEMPERATURE CONTROL OF PASSENGER CARS!

Electronic temperature and air conditioning control is particularly suited for railway passenger car use because it is not affected by vibration or changes in altitude.

Electronic control is many times more sensitive than present day control, and, of course, is extremely accurate. The control point may be set at the controller or at a remote point by merely adjusting a simple resistance unit, with immediate temperature change resulting. The thermostat may be split into two or more units or stretched across a wall, so that the temperature can be measured over a considerable area.

Another advantage of electronic control is that it permits the location of nearly every moving part in a central control panel. The thermostat itself can be made very small. It can be nothing more than a button or several buttons on the wall, averaging the temperature of the car or the compartment. Electronic control will be easily serviced through replacement of sub-assemblies. The service man need not be an expert in electronics. Watch for Honeywell electronic temperature and air conditioning control . . . Minneapolis-Honeywell Regulator Co., Railway Controls Div., 433 E. Erie St., Chicago 11, Ill.

MINNEAPOLIS
Honeywell
CONTROL SYSTEMS

BARBER-COLMAN

HIGH
TORQUE-WEIGHT
RATIO

•

SELF-CONTAINED
REMOTE BULB
ACTUATING ELEMENT

•

PROPORTIONING CONTROL

•

STABLE OPERATION

•

WIDE RANGE OF
APPLICATIONS

•

ACCURATE, DEPENDABLE

SELF-CONTAINED POWER UNIT

FOR AUTOMATIC WATER OR OIL TEMPERATURE CONTROL BY ADJUSTING SHUTTERS ON RADIATOR

On diesel engines, greater operating efficiency, lower operating costs, less engine wear, and lower maintenance costs can be achieved to a noticeable degree by using Barber-Colman Self-Contained POWER UNITS. For instance, on control of cooling water temperature, the bulb is set in the water jacket or any convenient place in the line or the radiator. The Power Unit is linked to the radiator shutters. If the water gets too hot, the shutters are automatically opened, *in one stepless true-proportioning motion without overrun or "hunting"*, to the correct position to provide the necessary cooling. Likewise, when the water gets too cool, the shutters are closed. The result is maintenance of uniform desired water temperature, with all the resulting benefits. The same principle of arrangement can be applied on oil coolers, and for numerous other purposes on railroad engines of all types. Barber-Colman Control equipment has proved its ability to do an accurate, dependable job in many applications for modern transportation equipment. Learn more about it. *Write for descriptive bulletins today.*

BARBER-COLMAN
COMPANY
ROCKFORD • ILLINOIS

BRING ON YOUR VIBRATION!

THE STOVER SELF-LOCKING NUT can "take it"!

When you have tested this *new-principle* self-locking nut, you will understand the true meaning of vibration resistance. You will see a precision-made nut which has been transformed into a powerful, metal spring. You will see the natural elasticity of metal employed to provide a mighty *grip* that defies vibration.

And yet the STOVER Self-locking Nut is a simple thing. It is in one piece with no complicated assembly. It does the whole job by itself. It locks at any point desired on the bolt and does no harm to the bolt threads. It can be used over and over without substantial loss of efficiency. It is made in standard sizes and threads from ¼ inch to 1½ inches. Finally, it costs no more than older-type less efficient lock nuts.

Send for descriptive literature and samples.

STOVER
"IT WON'T SHAKE LOOSE"

STOVER LOCK NUT AND MACHINERY CORPORATION

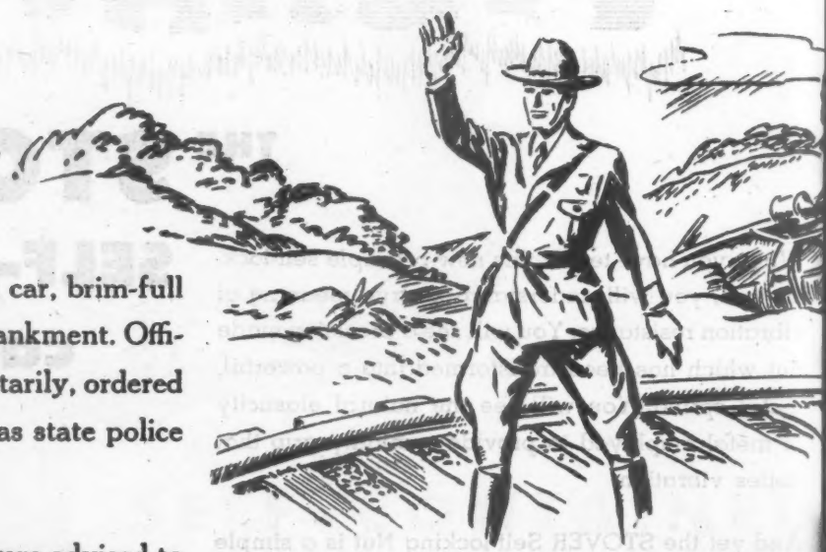
Easton, Penna., Bushkill Drive • New York 17, N. Y., 101 Park Ave.
REPRESENTATIVES IN PRINCIPAL CITIES

PATS. PEND.

MEETS ARMY AND NAVY SPECIFICATIONS

The STOVER Self-locking Nut is eliminating the loosening effect of vibration on many machines of war. Study it in relation to your postwar planning.

The LEAK that might have



ON a recent run, an a.c.f.-built tank car, brim-full with propane plunged down an embankment. Officials, fearful of an explosion momentarily, ordered cinders and earth shoveled over the tank as state police guarded the over-turned car.

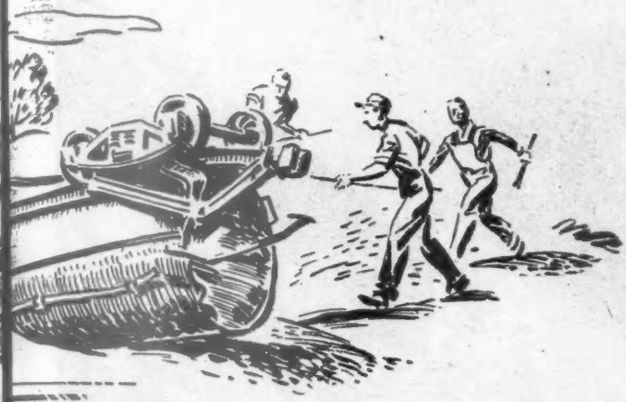
Fuel company representatives on arrival were advised to either transfer the propane to another car or return the cripple to the refinery. A thorough examination revealed however that despite the terrific impact — an impact that seemingly slated the car for scrap — there was no leakage of the lading! Hoisted onto a gondola, the car soon resumed its journey under the original bill of lading.

A mystery to some on the scene — but no secret to many operators of a.c.f. automatic, submerged, arc welded tanks is the "reason why" behind this car's superior protection of cargo. Time and again, a.c.f. tank cars have taken it hard but the know-how gained in 30 years of welding experience has enabled many a shipper and consignee under emergency conditions to take it easier!

a.c.f.

WHATEVER a.c.f. BUILDS—IT IS KNOWN TO BUILD WELL!

happened but DIDN'T!

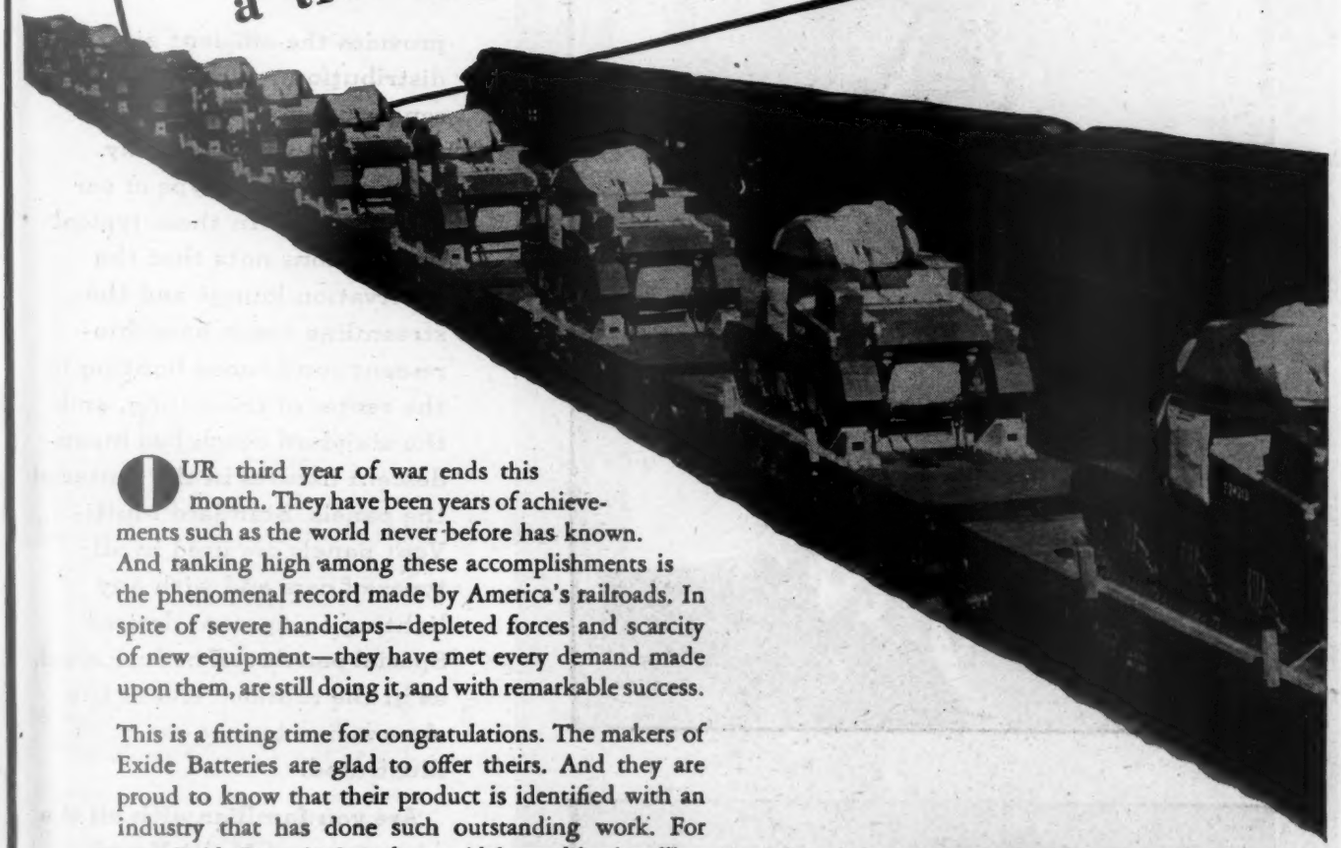


CAR AND FOUNDRY COMPANY

CLEVELAND • WASHINGTON • PHILADELPHIA • PITTSBURGH • ST. PAUL • SAN FRANCISCO


Season's Greetings
Early Victory--Lasting Peace
THE SAFETY CAR HEATING and LIGHTING COMPANY, INC.
NEW YORK - CHICAGO - SAN FRANCISCO - PHILADELPHIA - BOSTON - ST. LOUIS - MONTREAL
ARMY E NAVY

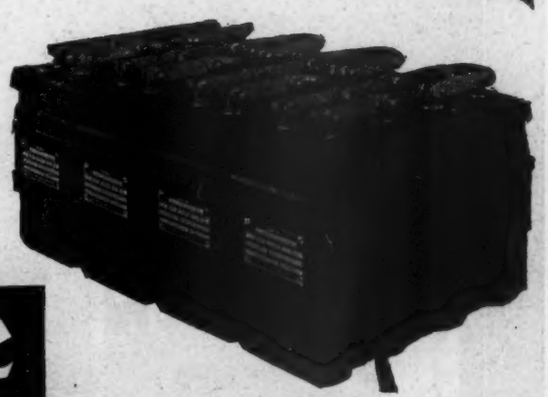
Getting there "first with the most" has been a transportation job



OUR third year of war ends this month. They have been years of achievements such as the world never before has known. And ranking high among these accomplishments is the phenomenal record made by America's railroads. In spite of severe handicaps—depleted forces and scarcity of new equipment—they have met every demand made upon them, are still doing it, and with remarkable success.

This is a fitting time for congratulations. The makers of Exide Batteries are glad to offer theirs. And they are proud to know that their product is identified with an industry that has done such outstanding work. For years Exide Batteries have been widely used in signalling systems, air-conditioning and car lighting, Diesel engine cranking, and other services.

And wherever Exide Batteries are used, railroad men have learned that they can count on their Exides for dependability, long-life, and ease of maintenance. They know that when they buy an Exide, they *Buy to Last.*



SUPPORT THE 6th WAR LOAN
LEND OVER HERE, TILL IT'S OVER, OVER THERE

ARMY E NAVY

Exide
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

★

MULTI-VENT

draftless ventilation

provides the efficient air distribution required for passenger comfort in modern equipment, and is readily adaptable to any type of car construction. In these typical installations note that the observation lounge and the streamline coach have fluorescent continuous lighting in the center of the ceiling, and the standard coach has incandescent fixtures in the center of the panels. Standard Multi-Vent panels are used in all types of cars and with any lighting equipment desired. Special panels can be furnished, as in the rounded end of the observation lounge car illustrated.

Are you familiar with all the advantages of Multi-Vent? Complete information will be sent upon request.

THE PYLE-NATIONAL COMPANY

1334-58 North Kostner Ave.
Chicago 51, Illinois

Offices: New York • Baltimore • Pittsburgh
St. Louis • St. Paul • San Francisco

Export Department:
International Railway Supply Co., New York

Canadian Agents:
The Holden Co., Ltd., Montreal

G-E lamps can provide cheerful light for eye comfort... create attractive surroundings in postwar dining cars. Plan now! "Empire State Express", New York Central System.

GOOD LAMPS ARE THE HEART OF ANY GOOD LIGHTING INSTALLATION

Buy G-E!

Here's News! G-E MAZDA Fluorescent lamps now available for everyone!

YES... now you can buy as many G-E Mazda fluorescent lamps as you need to replace blackened and burned out lamps. Today, your lighting can be brought to peak performance with new, low-cost, long-lasting G-E Mazda fluorescent lamps. When you make replacements, look for the G-E monogram. Remember . . . it is the constant aim of General Electric research to make lamps bearing this mark ● . . .

Stay Brighter Longer

G-E MAZDA LAMPS

GENERAL ELECTRIC

Hear the G-E radio programs: "The G-E All-Girl Orchestra", Sunday 10 p. m. EWT, NBC; "The World Today" news, every weekday 6:45 p. m. EWT, CBS. BUY MORE WAR BONDS

Most Capacity Per Pound—for Post-War Cars

When it comes to providing adequate capacity in the electrical systems on post-war cars with the least weight, an obvious solution is to select light-weight electrical equipment—including Edison Alkaline Batteries.

Not only are they the lightest weight type of battery available for railway-car service but they save weight where it counts most—near the middle of the car. The larger the kilowatt-hour capacity, the greater is the weight that can be saved by using alkaline batteries.

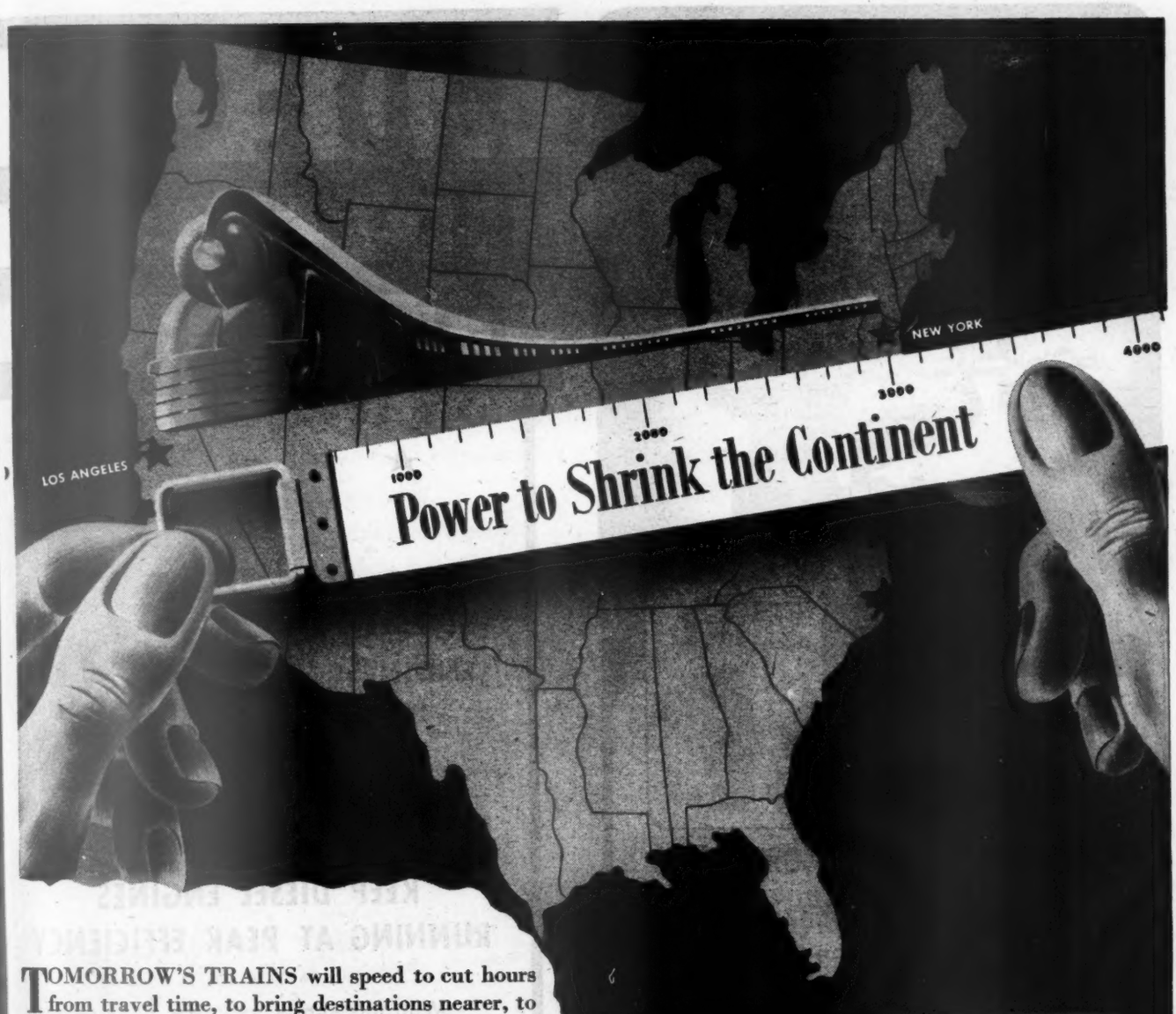
An outstanding reason for their light weight is their steel cell construction—a construction that gives alkaline batteries the further advantage of unequalled mechanical strength.

Alkaline batteries are equally suitable for use in 32-volt, 64-volt or 110-volt systems. They have been giving dependable service for many years in all three. *Edison Storage Battery Division of Thomas A. Edison, Incorporated, West Orange, New Jersey.*

Edison

THE LIGHTWEIGHT BATTERY
FOR LIGHTWEIGHT CARS

The electrical system of this modern streamlined car provides power for air-conditioning equipment, ample lighting, and a variety of electrical equipment in the kitchen, all of which, taken together, play an important part in passenger comfort, and emphasize the desirability of lightweight, dependable storage batteries. Post-war cars, too, are expected to make extensive use of electric power.



TOMORROW'S TRAINS will speed to cut hours from travel time, to bring destinations nearer, to seemingly shorten and shrink the distances we travel.

Many engineering achievements are now ready to help simplify the design and construction of America's future Marvels of Transportation. Among them are V-Belts already proved to have every quality desired by the makers of tomorrow's trains. They are the V-Belts created by Dayton Rubber, tough, smooth-running, strong, hard-gripping and long-lasting.

So every "drive" on tomorrow's trains (for Car Lighting, for Diesel Locomotives, for Air Conditioning) has its power-delivery factor all ready, through efficient Dayton V-Belts.

Being the only rubber manufacturer with a special railway division, Dayton Rubber, with 38 years of experience in both natural and synthetic rubber processing, assumes complete responsibility for providing V-Belts to help make possible the "Power to Shrink our Continent"—today . . . and tomorrow!

THE DAYTON RUBBER MFG. COMPANY
DAYTON 1, OHIO

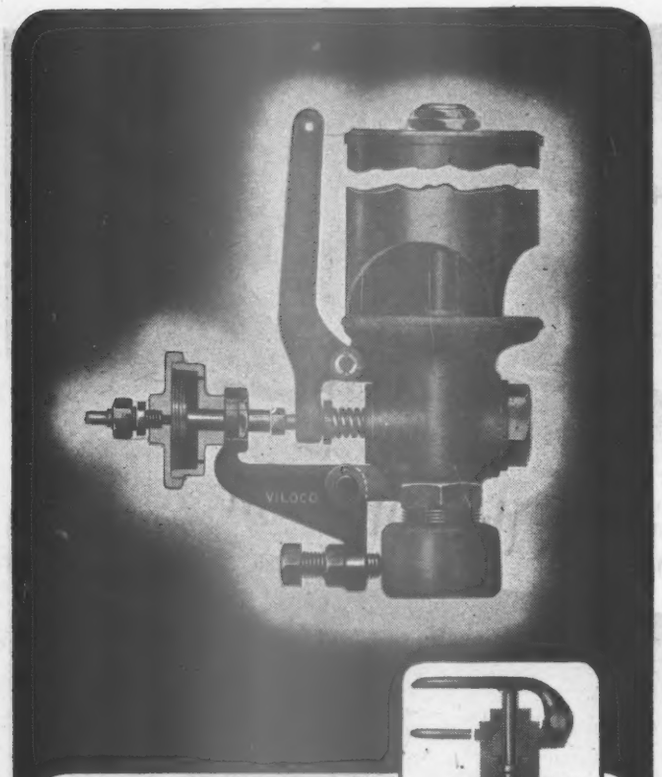
Pioneers of Railway V-Belts and Connectors
The World's Largest Manufacturer of V-Belts

★ LET'S ALL BACK THE ATTACK WITH WAR BONDS ★

Dayton V-Belt Fan Drive on Diesel Locomotives

V-Belts by Dayton Rubber

The Mark of Technical Excellence in Synthetic Rubber



Viloco

PNEUMATIC WHISTLE OPERATOR

The Viloco Pneumatic Whistle Operator, attached to the steam whistle with Operating Valve, conveniently located in the cab makes it easier for the engineer to sound warnings and signals.

A light "squeeze" of the valve handle effects instantaneous response of the whistle. An additional valve located on the fireman's side permits whistle to be operated from either side of the cab.

The application of this operator is especially desirable where the whistle is located near the front end of the locomotive as the complicated hand operating rigging is eliminated. The operating cylinder can be attached to any type of whistle by means of a suitable bracket.

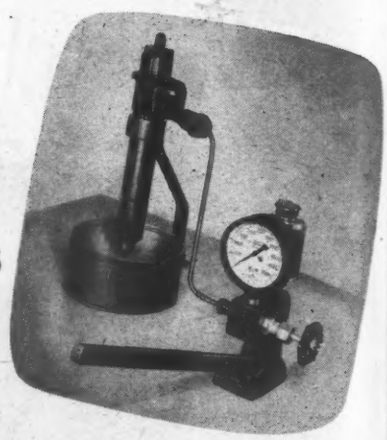
VILOCO RAILWAY EQUIPMENT CO.

332 SOUTH MICHIGAN AVENUE • CHICAGO

ADECO NOZZLE TESTER

★

FOR DIESEL ENGINES



KEEP DIESEL ENGINES RUNNING AT PEAK EFFICIENCY

With this sturdy, portable, light-weight Adeco Nozzle Tester, any mechanic can easily make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Adeco advantages have made this America's most widely used nozzle tester. Tests both large and small injectors, on bench or engine. Avoids costly delays and possible damage to engine. Keeps diesels operating at peak efficiency.

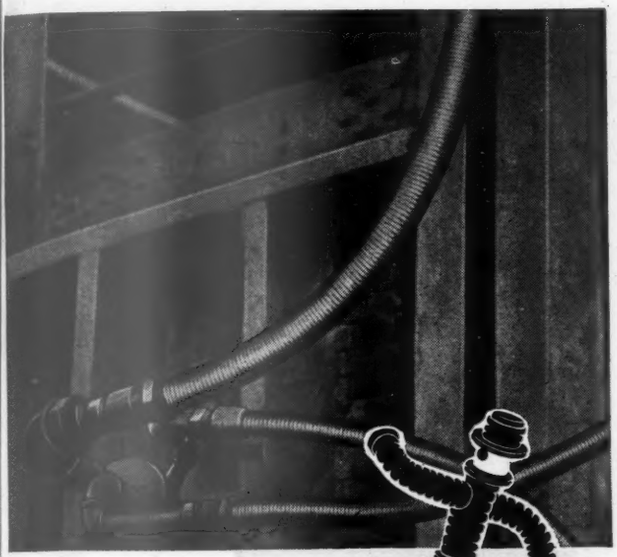
Write for new illustrated bulletin.

ADECO

AIRCRAFT & DIESEL EQUIPMENT CORPORATION

4411 NORTH RAVENSWOOD AVENUE

CHICAGO 40, ILLINOIS



Here's how REX-TUBE... licks maintenance problems

Chicago Metal Hose Corporation's "Rex-Tube" is used on many types of original equipment. In addition, this standard flexible metal hose is used for maintenance requirements throughout industry in general, frequently replacing more cumbersome and troublesome piping hook-ups.

The application *always* determines the type of flexible metal hose that should be used. Chicago Metal Hose Corporation manufactures the most diversified line of flexible metal hose products. Therefore, C.M.H. engineering recommendations are complete and unbiased.

The complete line of Chicago Metal Hose Corporation fittings makes installations easier and faster. If you are concerned with the replacement of flexible metal hose, write for complete information.

Flexible Metal Hose for Every Industrial Use

CMH CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

BUT NEW PRODUCTS NEED NEW FASTENINGS

To bring out the best in those new designs, you may need a fastener that has yet to be invented . . . a fastener that enables your product to do a better job.

Millions of Camloc quick-acting fasteners serve the aircraft industry on all fronts. Camloc designs fasteners to fit *precise* needs, and the accumulated knowledge and valuable experience that solved aircraft's fastener problems is at your service.

Whether you plan to make radios or vacuum cleaners, automobiles or washing machines, you'll find Camloc has much to offer.

CAMLOC
CAMLOC FASTENER CORPORATION

© Camloc Fastener Corp.

420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

FLEXO JOINTS

—wherever a flexible or swing joint is required.

FLEXO JOINTS are used for conveying steam, compressed air, water, gas, oil and other fluids under high or low pressure. They are made in 4 styles (illustrated below) and in all standard iron pipe sizes from ¼ inch to 3 inches for all pressures up to 1350 lbs. superheated steam.

FLEXO

Style "A"
For Revolving Machinery

Style "B"
For Right Angle Bends

Style "F"
Double Angle
Return Bend

Style "H"
Universal Joint.
Swings in All Directions

FLEXO JOINTS

are really trouble proof. Their simple, sturdy and practical design is responsible for the perfect service they give. Made of bronze with a liberal thickness of body wall to be positively safe. Their life is indefinite as they will outlast the pipe to which attached. FLEXO JOINTS will swivel through 360° yet there is no restriction of the flow of fluid through the fitting. There is a full pipe area in all positions. Any desired pipe line flexibility can be obtained by using a combination of the several styles of FLEXO JOINTS. They are easily and quickly installed, have long life, reasonable first cost and low, extremely low, maintenance cost. Try them; know how inexpensive and efficient they are.

COMPLETE BULLETIN SENT FREE

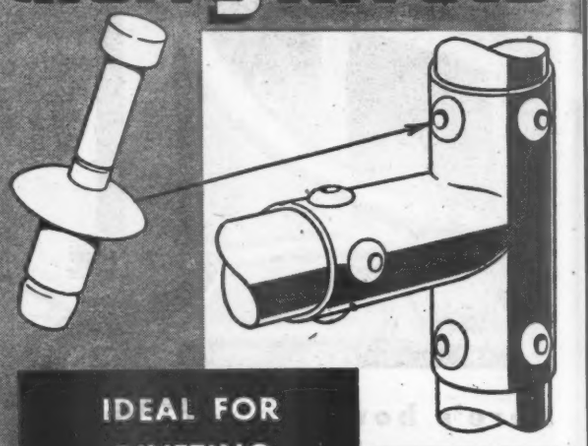
FLEXO SUPPLY COMPANY, Inc.
4223 Olive Str. St. Louis (8) Mo.

In Canada
S. A. ARMSTRONG, LTD.
115 Dupont Str. Toronto (5)

FLEXO

No- (Ground Parts
Springs

CUT PRODUCTION COSTS WITH Cherry Rivets



IDEAL FOR RIVETING TUBULAR ASSEMBLIES

Don't think of Cherry Rivets only as "blind" rivets. Just remember they are upset with a *pull instead of a pound* —that they need no bucking bar—no backing up—that they turn a *two-man* job into a *one-hand* operation.

Then you will use them in all hard-to-get-at spots (in corners—wherever space is limited). You will use them in all types of metal structures; you will use them in plastics, plywoods, enameled surfaces (the pull action doesn't crack or shatter brittle surfaces)—They will work in soft materials (rubber, leather, fabric) without bending, buckling or tilting the rivet.

With Cherry Rivets, short runs become production jobs without tooling or special set-up. Remember, too, that Cherry Rivets have wide tolerance in hole size and grip length—are fast to use and most economical.

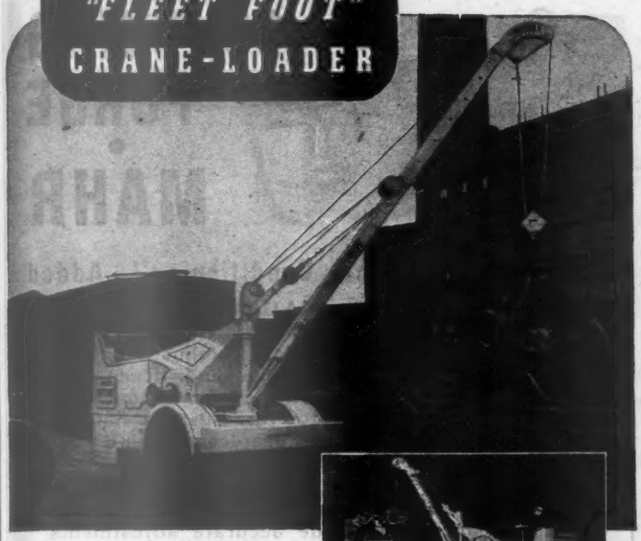
See for yourself how Cherry Rivets can cut production costs in your plant. Write for Handbook A-43. Address Department A-277, Cherry Rivet Company, 231 Winston Street, Los Angeles 13, California.

CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING

Cherry Rivet Company
LOS ANGELES, CALIFORNIA

POST-WAR EFFICIENCY TODAY!

JAEGER
"FLEET FOOT" CRANE-LOADER



Used as SHOP CRANE for handling, installing heavy parts.

Nimble
Powerful
Fast and Safe

Capacity
5 Tons

FAST TRUCK LOADER backs, lifts and swings simultaneously, ⅜ to 1½ yd. buckets—from ballast to cinders.

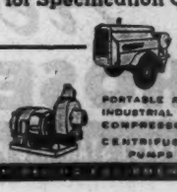
With its telescopic 12-18 ft. boom, the "Fleet Foot" can lift up to 5 tons faster than 1 ft. per second, swing full load 90° to either side without outriggers, tote it at up to 12 m.p.h. Compact: will pass 6½ x 8 ft. doorways, turn in 10½ ft. Husky: has plenty of traction to climb any steep ramp, pull cars or loaded trucks.

Correctly designed for its work by the world's largest builder of standard hoists: internal expanding friction clutch (same type as used on giant cranes) gives "touch control" of loads; 4-speeds for travel and all boom operations; instant automatic safety brakes; standard automotive controls; clear vision; no load ever above operator—fast, accurate, safe.

CAN CLIMB STEEP RAMPS

Three-point mounting, with boom load centered on driven wheels, means stability, greater traction as load increases: Gasoline powered.

For full details, ask for Specification CL-44.



THE JAEGER MACHINE COMPANY

300 DUBLIN AVENUE • COLUMBUS 16, OHIO

PORTABLE AND INDUSTRIAL AIR COMPRESSORS
CENTRIFUGAL PUMPS

HEMINGRAY INSULATORS

Favorably Known Since 1870

HEMINGRAY No. 10
The exchange line pony with double groove. Standard on many telephone lines.

Dependable—In Any Weather!

Hemingray Insulators are built to withstand *every* type of weather.

The exacting step-by-step quality production control makes them so tough and strong that sudden changes of temperature leave them unimpaired. They defy sun, rain, snow, hail and sleet.

One Hemingray user reports—*"thousands in continuous service for over 50 years."*

Hemingrays are sold by principal jobbers and are manufactured by Owens-Illinois, Hemingray Division, Muncie, Ind.

OWENS-ILLINOIS

HEMINGRAY INSULATORS

Telephone-Telegraph

Export Agents: International Standard Electric Corporation, New York City

GET TOGETHER DEPARTMENT

FOR SALE

POSITION OPEN

INDEX TO ADVERTISERS
DECEMBER, 1944

A

Aircraft & Diesel Equipment Corporation 114
Aircraft Standard Parts Co. 122
Airetool Mfg. Co. 119
Air Reduction Sales Co. 39
Ajax Manufacturing Company, The 13
American Arch Company, The 50
American Brake Shoe Company 88, 89
American Car & Foundry Company 104, 105
American Locomotive Company 54, 55, 62, 63
American Railway Products Co. 122
American Steel & Wire Co. 71, 84, 85
American Steel Foundries 83
American Tool Works Co., The 37
Anderson Mfg. Co., Albert & J. M. 131
Armco Railroad Sales Co. 35
Armstrong Bros. Tool Co. 124
Armstrong Cork Company 6
Association of Manufacturers of Chilled Car Wheels 47

B

Badeker Manufacturing Company 80
Baldwin Locomotive Works, The 4, 5
Barber-Coleman Company 102
Barco Manufacturing Co., Not Inc. 98
Beatty Machine & Mfg. Company 112
Broderick & Bascom Rope Co. 34
Bullard Company, The 19

C

Camloc Fastener Corp. 117
Carnegie-Illinois Steel Corporation 71, 84, 85
Chambersburg Engineering Company 38
Champion Rivet Company, The 20
Cherry Rivet Company 118
Chicago Metal Hose Corporation 117
Clark Company, Robert H. 11
Classified Advertisements 126
Climax-Molybdenum Company 60
Colin, Jr., Company, The J. S. 124
Columbia Steel Company 71, 84, 85
Consolidated Machine Tool Corporation 21
Crane Co. 30
Cullen-Friestedt Company 123

D

Dayton Rubber Mfg. Company, The 113
Dearborn Chemical Company 44
Diamond Machine Company 12
Durametallic Corporation 115

E

Edison Storage Battery Div., Thomas A. Edison, Inc. 111
Editor's Desk 42
Electric Storage Battery Company, The 107
Electro-Motive Division, General Motors Corporation 50a, 50b
Ex-Cell-O Corp. 116

F

Fafnir Bearing Company 92
Fairbanks, Morse & Co. 65
Firth-Sterling Steel Company 26
Flexo Supply Company 118
Flintkote Company, The 24
Franklin Railay Supply Company, Inc. 49

G

Garlock Packing Company, The 78
General Electric Company 14, 62, 63, 110
General Machinery Corp. 10
Get Together Dept. 126
Gisholt Machine Company 41
Grancell, I. H. 124

H

Hall Manufacturing Company, The 116
Hennessy Lubricator Co., Inc. 69
Holland Company 70

I

Independent Pneumatic Tool Company 28
Ingersoll-Rand Company 27
International Nickel Company, Inc., The 64, 74
Iron & Steel Products, Inc. 126

J

Jaeger Machine Company, The 121
Johnston Manufacturing Company 127
Jones & Lamson Machine Company 15

K

Keybolt Appliance Division, Hardinge Brothers, Inc. 127
King Machine Tool Company, The 43
Koppers Company, American Hammered Piston Ring Div. 68
Koppers Company, Wood Preserving Div. 97

L

LeBlond Machine Tool Co., The R. K. ..... Back Cover
Leslie Co. 67
Lima Locomotive Works, Incorporated 48
Lodge & Shipley Machine Tool Co., The 22
Lucas Machine Tool Co., The 32

M

MacLean-Fogg Lock Nut Company 7
Mahr Manufacturing Co., Div. of Diamond Iron Works, Inc. 122
Manganese Steel Forge Co. 33
Marchant Co., Geo. F. 127
McGill Manufacturing Co., Inc. 120
McKaig-Hatch, Inc. 122
McKay Company, The 31
Minneapolis-Honeywell Regulator Company 100, 101
Motor Wheel Corporation 115

N

National Bearing Metals Corporation 46
National Malleable and Steel Castings Co. 57a
National Tube Company 71, 84, 85
Nelson Specialty Welding Equipment Corp. 17

O

Oakite Products, Inc. 3
Owens-Illinois Glass Co. 121

P

Philco Corporation, Storage Battery Div. ..... 93-96 incl.
Pilliod Company, The 120
Post-Glover Electric Company, The 8
Prime Manufacturing Co., The 81
Products Mfg. Company 127
Pyle-National Company, The 108

R

Railway Accessories Company 120
Ransome Machinery Company 36
Republic Steel Corporation 73
Rockford Machine Tool Co. 16
Ryerson & Son, Inc., Joseph T. 9

S

Safety Car Heating and Lighting Company, Inc., The 106
Simmons-Boardman Publishing Corp. 112
Sinclair Refining Company 72
Snap-on Tools Corporation 123
Socony-Vacuum Oil Co., Inc. 58, 59
Standard Car Truck Company 61
Standard Electrical Tool Co., The 120
Standard Oil Co. of California 77
Stover Lock Nut & Machinery Corporation 103
Sturtevant Company, B. F. 90, 91
Superior Railway Products Corp. 66

T

Tennessee Coal, Iron & Railroad Company 71, 84, 85
Thomas Machine Manufacturing Co. 125
Timken Roller Bearing Company, The 79
Tinnerman Products, Inc. 109, 125
T. Z. Railway Equipment Co. 115

U

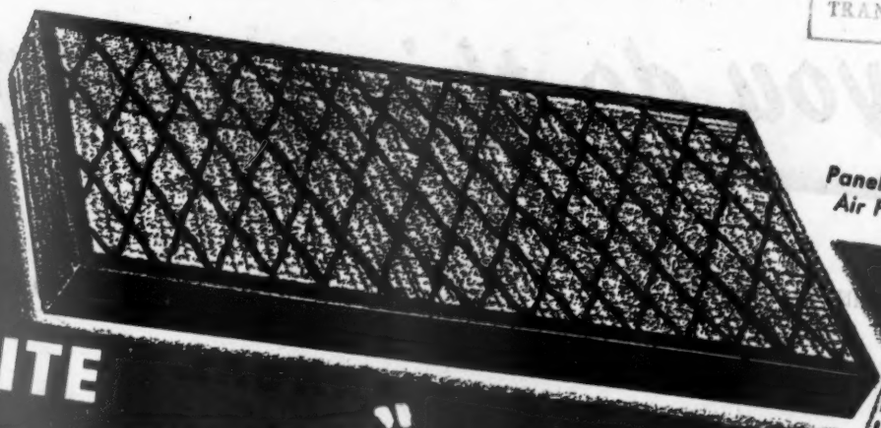
H. B. Underwood Corp. 125
Union Asbestos and Rubber Co. 82
Union Switch & Signal Co. 56, 57
Unit Truck Corporation 2
U. S. Metallic Packing Co., The 125
U. S. Steel Corporation 71, 84, 85
U. S. Steel Export Co. 71, 84, 85
Universal Vise & Tool Co. 119

V

Viloco Railway Equipment Co. 114

W

Walworth Company 40
Warner & Swasey Co. 25
Watson-Stillman Co., The 29
Waugh Equipment Company 99
Waukesha Motor Company 75
Wells, Martin 23
Westinghouse Air Brake Co. 52, 53
Westinghouse Electric & Manufacturing Company 4, 5, 86, 87
Whiting Corporation 18
Wilkening Manufacturing Co. 76
Willson Products, Incorporated 124
Wine Railway Appliance Co., The ..... Front Cover



Panel Type Air Filter

OAKITE "ON TIME" FILTER CLEANING

FASTER . . . EASIER Way to Clean Diesel Filtering Units

Lube Oil Filter Unit

Sinter Bronze Type Filter Unit

IF you want a successful, low-cost procedure for cleaning Diesel lube oil, fuel oil and air filtering units, ask us to send you data describing how fast-working Oakite materials enable you to expedite this important maintenance work more easily on a MASS PRODUCTION basis.

Already used on many Class 1 roads, these specialized Oakite materials and easily installed techniques are today's best and most practical answer to the efficient cleaning and maintenance of filter units.

"KEEP POWER ROLLING"

ASK US ABOUT TIME-SAVING OAKITE METHODS FOR:

- Cleaning Valve Gear
- Degreasing & Decarbonizing Diesel Engine Pistons
- Back Shop Tank Degreasing
- Reclaiming Triple-Valve and Other Rubber Gaskets
- Washing Engine Tanks & Cabs
- Descaling Diesel Cooling Systems Safely
- Cleaning Air Compressors

Sinter Bronze and Doughnut Type Filters

IN addition to helpful diagrams . . . drawings . . . working details, a special chapter in this Service Report deals with sinter bronze and Doughnut type Diesel filters and time-saving methods for cleaning and reconditioning them. Also included is an effective set-up for economically cleaning panel or box type air filters on a mass production basis. This factual Oakite Service Report is FREE to all Mechanical Supervisors . . . write for it TODAY!

OAKITE PRODUCTS, INC., WRIGLEY BUILDING, CHICAGO 11, ILL.

In Canada: OAKITE PRODUCTS OF CANADA, LTD.
TORONTO: 65 Front St. East—MONTREAL: 1 Van Horne Ave.

OAKITE

RAILWAY SERVICE DIVISION

Do you do this ANNUALLY?

BALDWIN-WESTINGHOUSE INSPECTION RECORD

ELECTRICAL INSPECTION

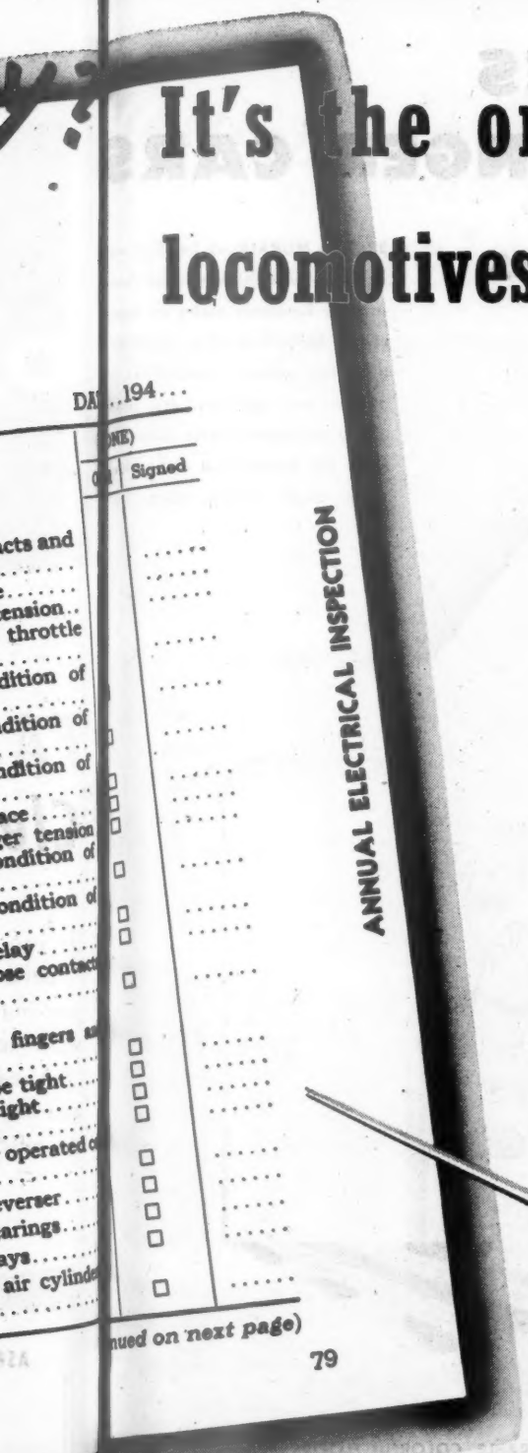
ANNUAL

LOCOMOTIVE NUMBER..... MILES..... DA..194.

	(CHECK ONE) OK	Corrected	Signed
A. *Traction Motors*			
1. Clean oil, grease and dirt from motors	☐	☐	.....
2. Blow out motors	☐	☐	.....
3. Lubricate gears if necessary	☐	☐	.....
4. Examine brushes and holders. Clean insulators	☐	☐	.....
5. Examine commutators	☐	☐	.....
6. Examine stringbands, bandwire, insulation	☐	☐	.....
a. Wipe these parts clean	☐	☐	.....
7. Clean dirt from around field coils	☐	☐	.....
8. Examine motor leads for chafing or damage	☐	☐	.....
9. Oil axle bearings	☐	☐	.....
10. See that all covers are tight	☐	☐	.....
11. Grease armature bearings	☐	☐	.....
12. Repack axle bearings	☐	☐	.....
B. *Generator, Auxiliary Generator, Exciter*			
1. Clean oil, grease and dirt from frames	☐	☐	.....
2. Blow out generating units	☐	☐	.....
3. Inspect main generator coupling	☐	☐	.....
4. Examine brushes and holders. Clean insulators	☐	☐	.....
5. Examine commutators	☐	☐	.....
6. Examine stringbands, bandwire, insulation	☐	☐	.....
a. Wipe these parts clean	☐	☐	.....
7. Clean dirt from around field coils	☐	☐	.....
8. Examine all cables, wires, straps	☐	☐	.....
9. Grease generator bearing	☐	☐	.....
10. Grease auxiliary generator-exciter bearings	☐	☐	.....

	Ok	Signa
C. *Control*		
1. Examine throttle drum contacts and fingers		
a. Lubricate contact surface		
b. Check for proper finger tension		
2. Examine electrical parts of throttle operator		
3. Check operation and condition of air operated contactors		
4. Check operation and condition of magnetic contactors		
5. Check operation and condition of reverser		
a. Lubricate contact surface		
b. Check for proper finger tension		
6. Check operation and condition of relays		
7. Check operation and condition of voltage regulator		
8. Check reverse current relay		
9. Check resistors—no loose contacts or burns		
10. Miscellaneous:		
a. Check all interlock fingers and contacts		
b. All connections to be tight		
c. All supports to be tight		
d. All insulation clean		
11. Lubricate pistons—air operated contactors		
12. Lubricate pistons—reverser		
13. Lubricate reverser bearings		
14. Check settings of relays		
15. Recondition control air cylinders needed		

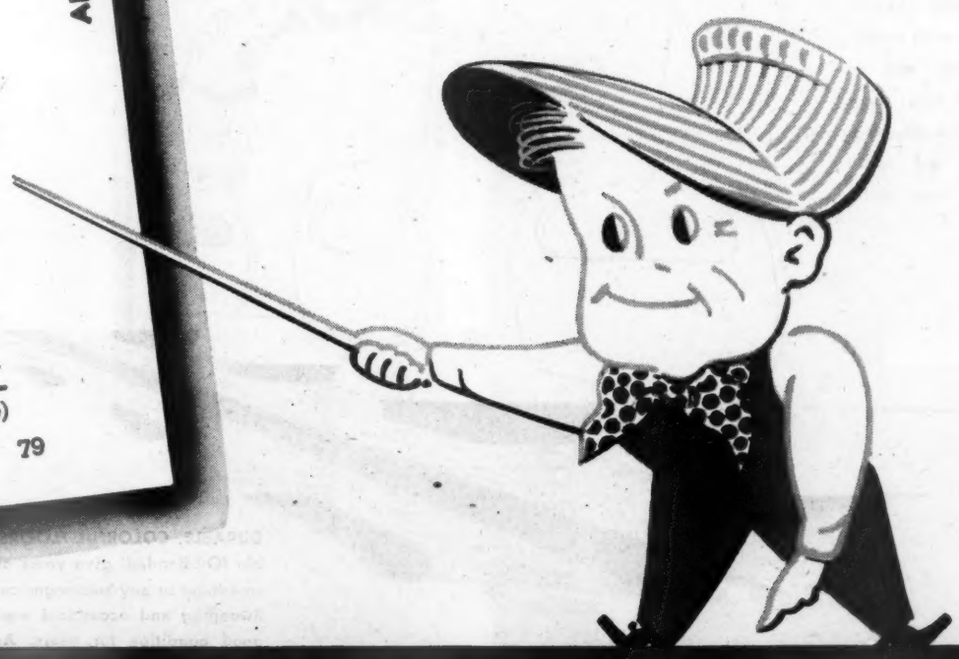
It's the only way to keep your locomotives in *Fighting Trim*



When your Baldwin-Westinghouse Locomotives have a birthday, the finest way to celebrate the occasion is with a *planned* check-up because that's the way to insure another 365 trouble-free days of dependable service.

This specimen record sheet from the Baldwin-Westinghouse Guide shows how the work can be simplified and certified. Checking is itemized, step-by-step, no chance for anything to be overlooked or forgotten. And the sheets become a permanent detailed maintenance record.

Ask for full information on the planned inspection service that pays out in thousands of extra miles.



Westinghouse

LOCOMOTIVES

THE BALDWIN LOCOMOTIVE WORKS
Advertising Department
Paschall P. O., Phila. 42, Pa.
Please send information on your inspection and maintenance checking system.

NAME _____
TITLE _____
COMPANY _____
ADDRESS _____

ADVANCE STYLE NOTES FOR POST-WAR PASSENGER CARS

Coaches

BRIGHT MURALS of hand-carved or sandblasted heavy gauge Armstrong's Linoleum make an especially decorative—and durable—bulkhead surface. Possibilities of design and coloring are practically unlimited. Extra tints and tones can be sprayed or brushed on to create special effects.

BAGGAGE RACK is surfaced with Armstrong's Linowall—the same material used on the sidewalls. Tough, flexible Linowall is easily formed around curves of small radius. Used behind racks and on ceiling, Linowall takes baggage bumps without chipping. Dirt is quickly and easily removed with a damp cloth.

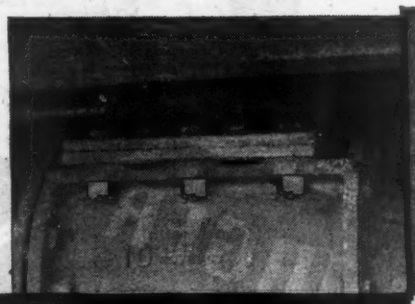
DURABLE, COLORFUL FLOORS of Armstrong's Linotile (Oil-Bonded) give years of service—add lasting smartness to any passenger car. Cleaning is simple. Sweeping and occasional washing keep Linotile in good condition for years. **Armstrong's Cork Base** underlayment saves weight and resists indentation. It can be used over any type of floor plate.

ARMSTRONG'S floor and surfacing materials have stood up so well under extra-heavy wartime wear that many designers are specifying more extensive usage of these materials in post-war passenger cars. For complete information about Armstrong's Linoleum, Linowall, Linotile, and Cork Base, write Armstrong Cork Company, Transportation Products Dept., 7412 Arch St., Lancaster, Pennsylvania.

ARMSTRONG'S
FLOORS and SURFACING MATERIALS
for passenger cars

Where to use "M-F" LOCK NUTS
on freight car underframes

Draft Gear Carrier Arm
•
M-F Lock Nut No. 1 with common nut

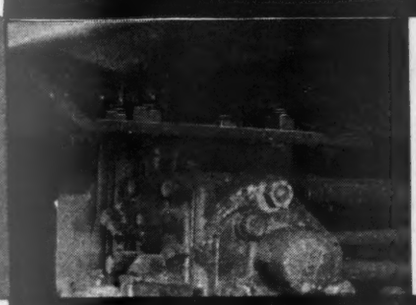


Brake Cylinder to bracket
•
M-F Lock Nut No. 3

Brake Cylinder Reservoir to bracket
•
M-F Lock Nut No. 3

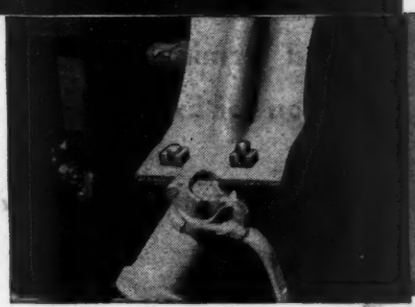
Badge Plate
•
M-F Speed Nut

A B Valve to bracket
•
M-F Lock Nut No. 3



Pipe clamp
•
M-F Speed Nut

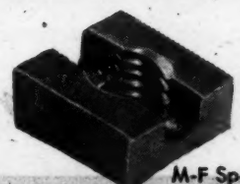
Coupler carrier
•
M-F Lock Nut No. 1 with common nut



Angle Cock Holder
•
M-F Speed Nut

A type and size to meet every requirement

M-F Lock Nut No. 1



M-F Speed Nut No. 2

M-F Lock Nut No. 3

MACLEAN-FOGG LOCK NUT COMPANY

2649 N. Kildare Avenue, Chicago 39, Illinois • *In Canada: The Holden Co., Ltd., Montreal*

FOR LONGER RESISTOR LIFE *Specify . . .*

Nonbreakable

P-G STEEL GRID RESISTORS

- ★ All Steel Construction
- ★ Mica Insulation
- ★ Rugged Terminals
- ★ Provision for Expansion
- ★ Adequate Ventilation
- ★ Unaffected by Vibration
- ★ Moisture Resistant
- ★ Corrosion Protected

These features combined insure long Resistor Service Life

WRITE FOR BULLETIN No. 500

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI, OHIO

GET YOUR COPY OF THE LATEST RYERSON MACHINERY AND TOOLS CATALOG—WRITE TODAY

Here's a new condensed buying reference for all types of metal-working machines and tools. It describes over two hundred different types of equipment and lists data on capacities and capabilities for the fabrication of bars, plates, structurals, sheets, tubing, pipe, etc. This supplements our special Ryerson line of flue shop equipment for cleaning and safe-ending of locomotive tubes and flues, also our spring shop equipment.

Our Machinery Department is staffed with men who have acquired an intimate knowledge of specialized metal-working equipment. These men are always glad to lend their experience and help you on any problem of machinery selection or application. Get in touch with the Ryerson plant nearest you for prompt action.

JOSEPH T. RYERSON & SON, INC., PLANTS AT: CHICAGO, MILWAUKEE, ST. LOUIS, CINCINNATI, DETROIT, CLEVELAND, BUFFALO, BOSTON, PITTSBURGH, PHILADELPHIA, JERSEY CITY.

RYERSON

What makes 'em TICK...

HAMILTON ENGINES

BUT KEEP THAT GUARD UP!

Hamiltons power one-third of all the Liberty Ships.

The pendulum swings with them to victory.

GENERAL MACHINERY CORPORATION

GENERAL MACHINERY CORPORATION

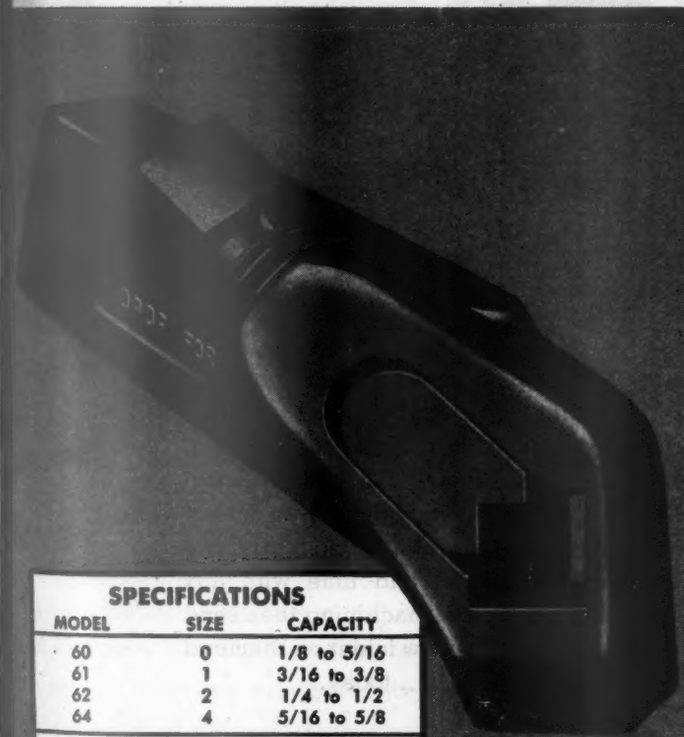
HAMILTON, OHIO

THE NILES TOOL WORKS CO. • THE HOOVEN, OWENS, RENTSCHLER CO. • GENERAL MACHINERY ORDNANCE CORPORATION

GOT IT!

A TOOL HOLDER with 10 Times the Grip

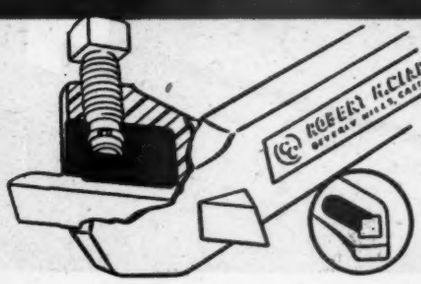
Tests show the new Clark Adjustable Tool Holder has the same rigidity as solid forged tools. Exclusive vise-grip jaw has twice the width and five times the length of the bearing surface found in other tool holders ... runs the *full* length of the cutter channel. Takes four sizes of round or square bits, large or short stub bits, undersize or out-of-round bits ... carbide bits and boring bars, and bits of brittle alloy. Double angle of head gives operator an unobstructed view of the cutting edge for better work control.



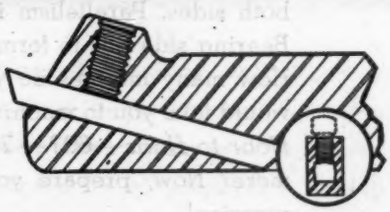
SPECIFICATIONS

MODEL	SIZE	CAPACITY
60	0	1/8 to 5/16
61	1	3/16 to 3/8
62	2	1/4 to 1/2
64	4	5/16 to 5/8

With 15° or parallel cutter channel either left or right hand



Vise-grip jaw in the Clark Adjustable Tool Holder runs the full length of the cutter channel.



Conventional types hold tool bits at only one point, often causing bits to sag, or to be damaged or broken.

Write for complete Catalog M-11

Adjustable Hole Cutter

Grinding Fixture

CLARK CC CUTTERS

Robert H. Clark Company

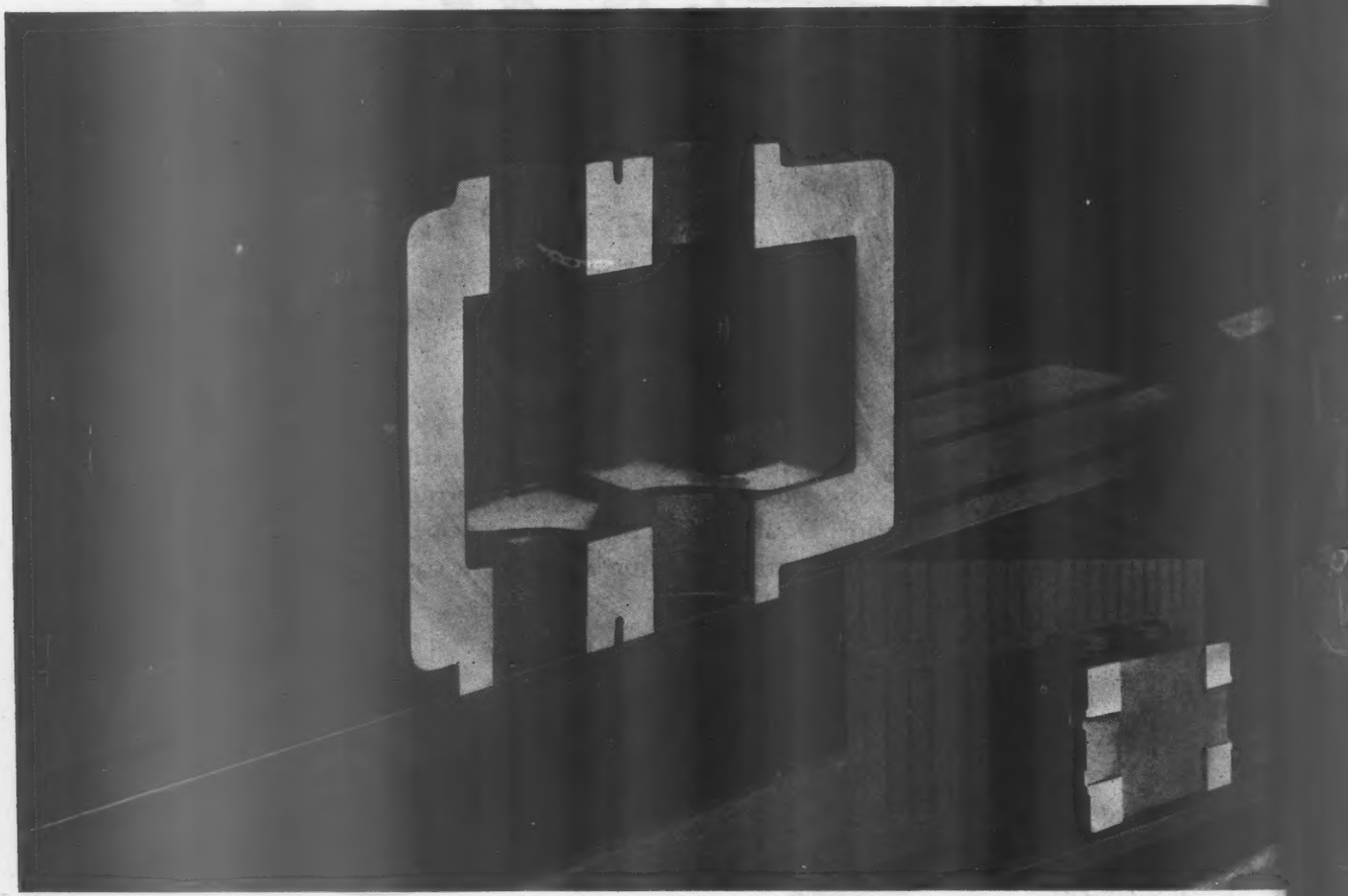
9330 SANTA MONICA BOULEVARD • BEVERLY HILLS, CALIFORNIA

Adjustable Counterbore

Adjustable Facing Mill

ADJUSTABLE CUTTING TOOLS FOR ALL MATERIALS

HOW LONG WOULD IT TAKE YOU TO MACHINE THIS PIECE FLOOR-TO-FLOOR?



Take a good look at this job—a close-grained grey iron gear housing measuring 18¼" x 14". Has to be faced both sides. Parallelism is important. Bearing side has to form an oil seal. How many minutes do you figure it would take you to machine this piece *floor-to-floor*—60?—70?—80? or more? Now, prepare yourself for a surprise!

Facing both sides floor-to-floor with a Diamond Face Grinder requires just *12 minutes,* removing a total of ⅝" stock! Piece is held by a magnetic chuck only, without even a bearing on platen while facing feet! Compare the finish and time with any other method of machining then send coupon for the new folder on Diamond Face Grinders . . . today.

"THE DIAMOND D THAT CUTS YOUR COSTS"

Diamond Machine Company of Philadelphia
2510 Aramingo Avenue, Philadelphia 25, Pa.
Gentlemen: ☐ Send your Bulletin 44-G which shows how to step-up production with the Diamond Face Grinder

Name_____
Company_____
Address_____ State_____
City_____

The Advantages of High-Speed Forging During War Production

Points the Way to Production Advantages for Post-War

★ The production of press forgings for war materiel in such tremendous volume and to such exacting specifications as to enable that materiel to withstand the severity of war service has proven, through these years of intensive production and rigorous use, the superiority of Press forging over older, slower and less accurate methods.

Ajax High-Speed Solid Frame Forging Presses have demonstrated so many advantages in the high production of forgings, both hot and cold, and coining to such a high degree of economy and accuracy, that their important place in the production of forgings for the highly competitive peace-time markets is obvious.

Those operators of production forging equipment who have installed these modern, accurate, dependable high-production, Presses, and become thoroughly familiar with their great production capabilities, will be in an enviable position in post-war competition.

★

WRITE FOR BULLETIN No. 75
to Post Yourself on the Advantages of High-Speed Press Forging

THE
AJAX
MANUFACTURING
COMPANY

EUCLID BRANCH P. O., CLEVELAND 17, OHIO
621 MARQUETTE BUILDING • CHICAGO 3, ILLINOIS

FLAMENOL

Simple test demonstrates value of G-E synthetic cable

Before you install wiring in a location where there is danger of fire, *first* make this test:

Light a match, and hold a piece of Flamenol* wire in the flame. Use several matches, one after another. The insulation will char, but it will *not* burst into flame. Therefore, Flamenol gives you this assurance: If fire *does* break out, *it will not be spread by the wiring.*

Flamenol Has Proved Itself

The insulation on Flamenol wire and cable is *not* a newly developed and temporary substitute. Designed to overcome the disadvantages inherent in other insulations, it has been in commercial use more than *eight years.* Its many advantages, listed at right, have been proved under severe conditions of service in thousands of industrial installations.

As a result of thorough tests carried out over long periods of time, many of the country's leading chemical, oil, automotive, and other companies changed to Flamenol long before the rubber shortage. For further information, constructions, suggested uses, etc., write to the nearest G-E office. *General Electric Company, Schenectady, N. Y.*

*Reg. U.S. Pat. Off.

12 BIG ADVANTAGES offered by FLAMENOL

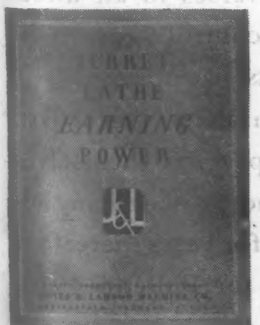
1. FLAME RESISTANCE—does not support combustion.
2. CORROSION RESISTANCE—immune to action of oils, acids, alkalies.
3. SUPER-AGING — does not oxidize. Highly resistant to sunlight and weathering.
4. EXCELLENT PHYSICAL PROPERTIES—has minimum tensile strength of 1500 lb per sq in., minimum elongation of 100 per cent.
5. DIELECTRIC STRENGTH — retained at about 720 volts per mil through severe operating conditions.
6. SMALL DIAMETER — saves space, facilitates wiring.
7. SMOOTH SURFACE—facilitates pulling through conduit.
8. FREE STRIPPING—speeds splicing, avoids nicking conductors.
9. DIFFERENT COLORS —simplify circuit tracing.
10. VARIOUS CONSTRUCTIONS—aid selection for special applications.
11. SELF-PROTECTING FINISH — eliminates need for braid, less space required.
12. ATTRACTIVE APPEARANCE—is maintained through long service, painting is never needed.

BUY WAR BONDS

GENERAL ELECTRIC

Economy starts with *modernization*

To Modernize, with Jones & Lamson Universal Turret Lathes, is *to Economize*. All the essentials for fast, economical turret lathe production are built into these machines. Rigidity, Speed, Power and Ease of Operation are combined in them to take full advantage of modern fast-cutting tools with minimum fatigue to the operator. A complete line of Universal Turret Lathes, with from 1½ inches to 8 inches bar capacity, is available for railroad maintenance and shop requirements. Our book, Turret Lathe Earning Power, will tell you more about the productive advantages of these machines, and will be sent to you upon request.



JONES & LAMSON
MACHINE COMPANY
Springfield, Vermont, U.S.A.

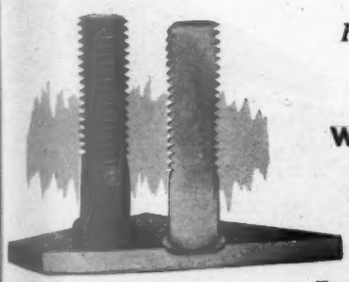
Manufacturer of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.

Complete fusion of stud to metal in less than 1/2 second...

The Nelson Stud Welder is simple to operate because the welding is *automatically* controlled. It eliminates the need for drilling, tapping, and hand welding bolts to secure parts, because it end-welds studs directly to the metal surface.

It is used by more than 460 industrial plants and shipyards. Operators are securing 500 to 1500 studs a shift. No previous welding experience is necessary to operate it.

Complete fusion of the stud to metal is obtained by accurate arc timing control, automatic action of the "gun," the use of flux-filled studs, and complete shielding of the arc.



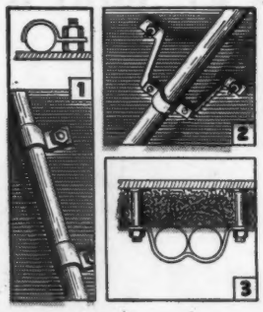
Cutaway view of stud, after etching with Nital.

For complete data, catalog and price list, write:

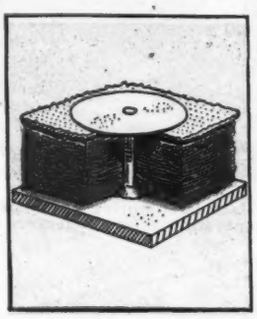
NELSON SPECIALTY
WELDING EQUIPMENT CORPORATION
Dept. R, 440 Peralta Avenue
San Leandro, California

Eastern Representative: Camden Stud Welding Corp. Dept. 22, 1416 South Sixth St., Camden, N. J.

TYPICAL STUD APPLICATIONS



Wiring, conduit, and pipe are quickly secured. Here illustrated are a few methods: 1. Securing conduit. 2. Securing pipe (single and multiple runs). 3. Securing wiring of all kinds over soft insulation material.

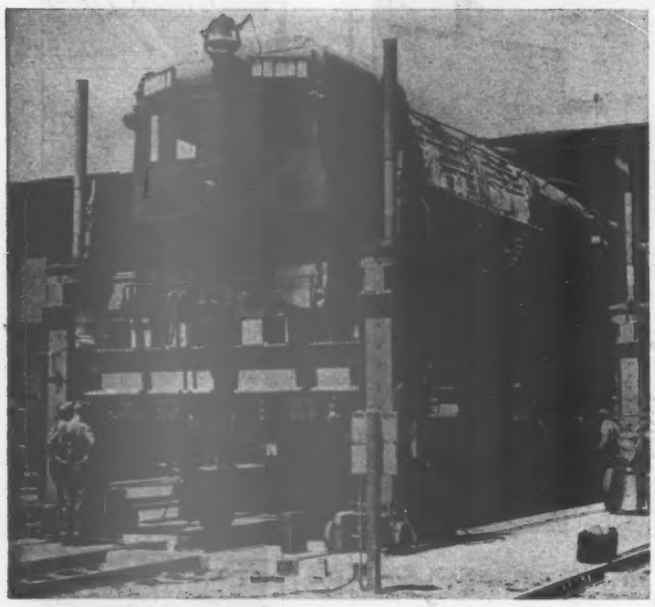


Nelson Insulation Pins are used to secure soft insulation rapidly and economically. They are welded directly through the material without injury to it. Where large metal surfaces must be insulated these pins will save both time and material.

Wood flooring is secured over metal beams with studs. The flooring is laid, and holes drilled where desired. Studs are welded through the holes and nuts and washers tightened down. A wooden plug is then tapped in to complete the job.

NELSON STUD WELDERS & STUDS

CUT MAN-HOURS—SAVE LABOR—SPEED HEAVY REPAIR

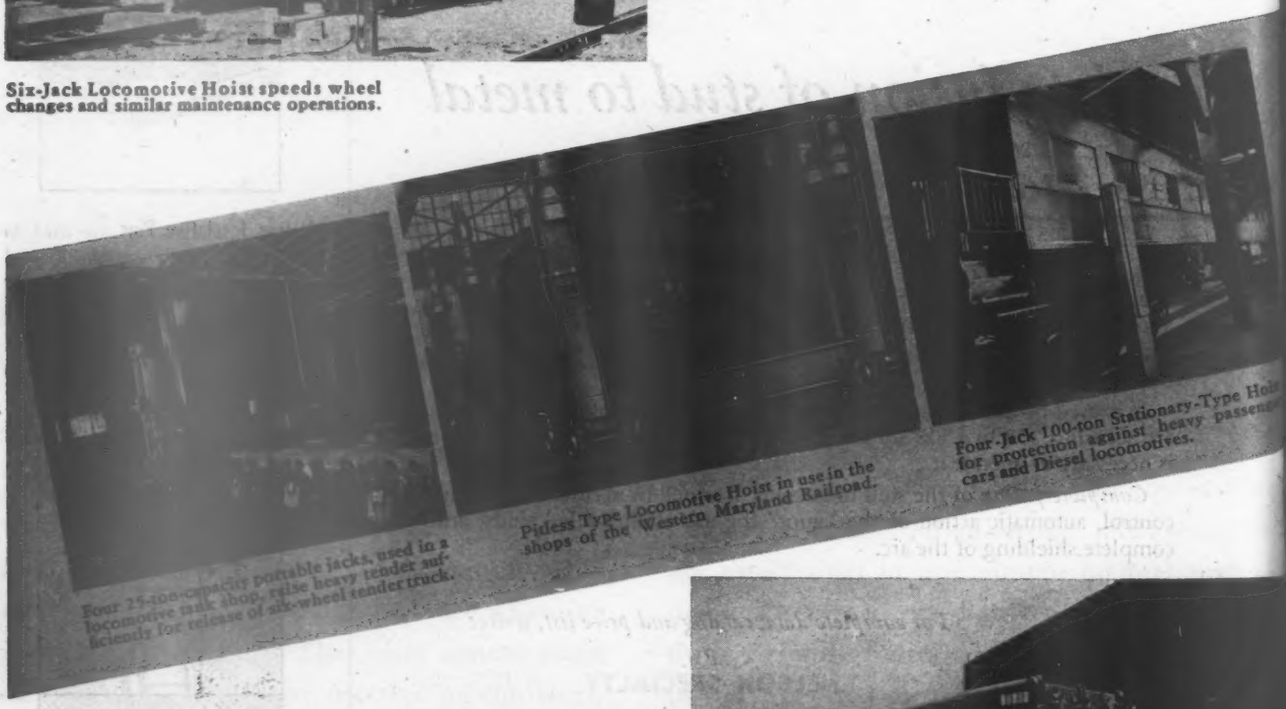


Six-Jack Locomotive Hoist speeds wheel changes and similar maintenance operations.

Use these economically operated hoists

Meet wartime emergencies with efficient maintenance equipment—help prevent work from piling up in your engine houses and back shops. Speed up wheel changes and similar service jobs. Use Whiting Hoists, and get unusual savings in time, manpower, and operating costs.

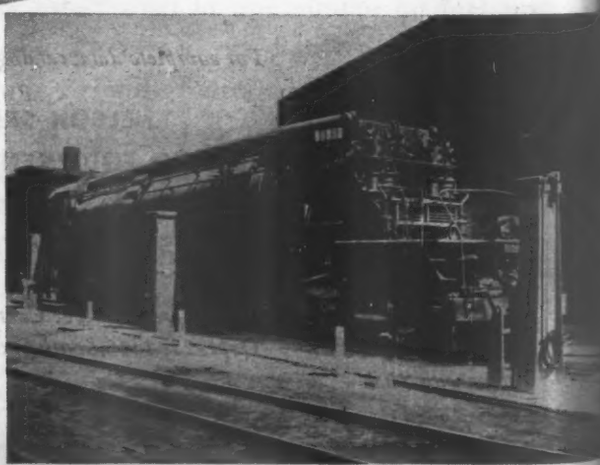
Check the possibilities of Whiting Hoists today—both pitless and pit types. Whiting engineers will gladly cooperate with you in solving your maintenance problems; write for details.



Four 25-ton-capacity portable jacks, used in a locomotive tank shop, raise heavy tender sufficiently for release of six-wheel tender truck.

Pitless Type Locomotive Hoist in use in the shops of the Western Maryland Railroad.

Four-Jack 100-ton Stationary-Type Hoist for protection against heavy passenger cars and Diesel locomotives.



Six-Jack 360-ton-capacity Locomotive Hoist for handling heavy power.

WHITING
CORPORATION

15609 Lathrop Avenue, Harvey, Illinois

RAILROAD MAINTENANCE EQUIPMENT

DROP PIT TABLES • LOCOMOTIVE HOISTS • HIGH-LIFT JACKS • LOCOMOTIVE SPOTTERS • CAR WASHERS • CINDER CONVEYORS • TRANSFER TABLES CROSSOVER BRIDGES

Offices in Chicago, Cincinnati, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, and Washington, D. C. Agents in other principal cities. Canadian Subsidiary; Whiting Corporation (Canada) Ltd., Toronto, Ontario.

High Speed Production of CYLINDER BUSHINGS and Small JOBS . . . . .

WHILE BULLARD engineers designed the High Bed 54" Vertical Turret Lathe especially for the machining of cylinder bushings, they did not overlook the fact that the average railroad shop could not keep this unit busy on this job alone—therefore, they proceeded to mix a lot of versatility into the design.

Removal of the special boring bar and lowering of the side rail quickly converts this unit into a standard 54" V.T.L. As the illustrations show, it is just as adaptable for valve bushings as well as cylinder bushings. Production on small jobs compares very favorably with the smaller sized and speedy V. T. Ls.

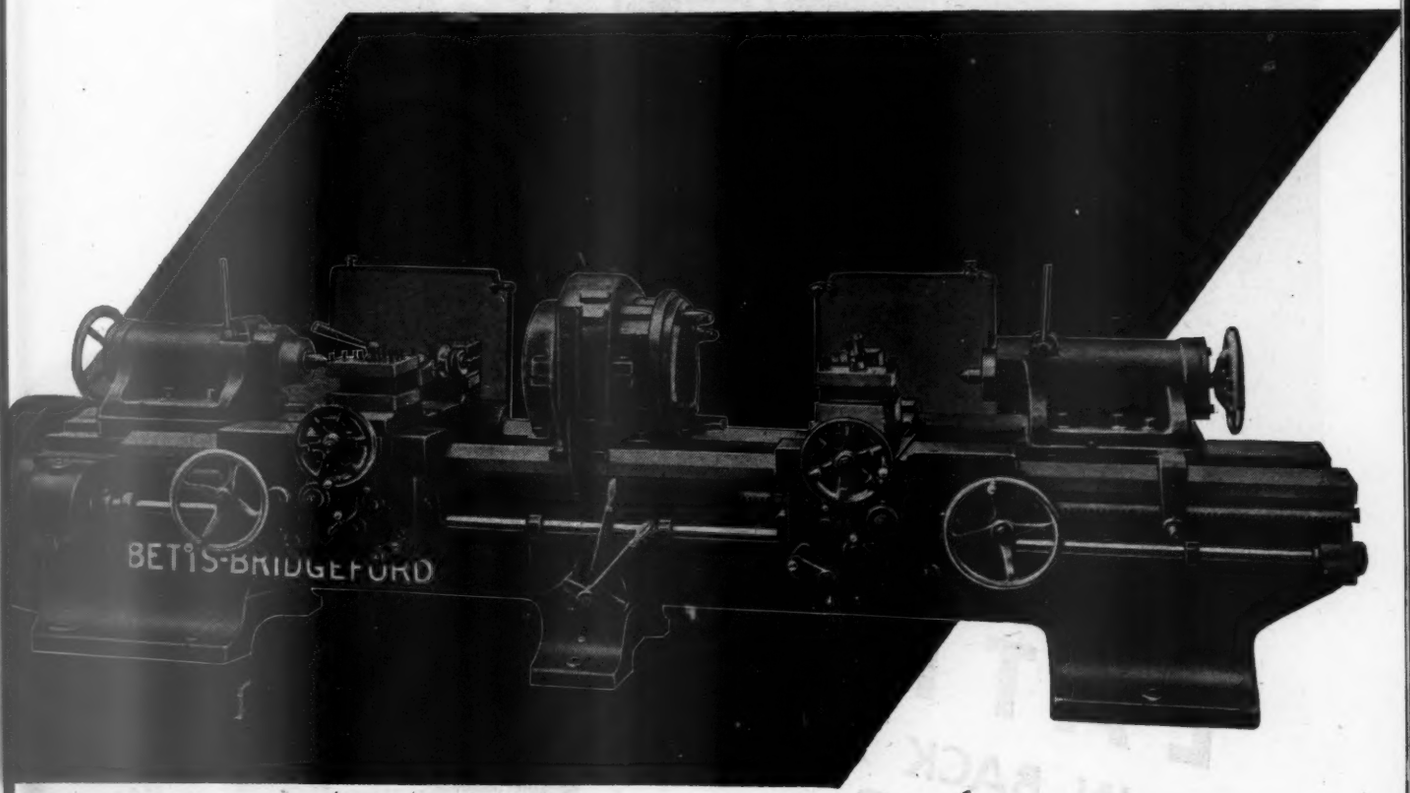
BULLARD HIGH BED 54" V.T.L.

THE BULLARD COMPANY

BRIDGEPORT, CONNECTICUT

"I know what's the matter, Mom—nobody gave him any CHAMPION WELDING ELECTRODES!"

LET THIS MACHINE HELP TO CUT YOUR AXLE PRODUCTION COSTS



BETTS-BRIDGEFORD HEAVY-DUTY CENTER-DRIVE AXLE LATHE

- **MAXIMUM PRODUCTION**
- **GREATER ECONOMY**
- **POSITIVE ACCURACY**
- **LASTING SERVICE**

For the Railroad Shop

The BETTS-BRIDGEFORD Center Drive Axle Lathe is designed for rapid turning and burnishing of journals, and for turning wheel fits on standard car axles from 4¼" x 8" up to and including 6½" to 12", new axles or those to be re-conditioned. Its massive, rugged construction insures a long period of productive life. Simplified design and elimination of complicated mechanisms make it more convenient and easy to operate and control. Bulletin No. 1312 gives detailed information. Your copy will be sent upon request.

BETTS • BETTS-BRIDGEFORD • NEWTON • COLBURN • HILLES & JONES • MODERN

CONSOLIDATED MACHINE TOOLS

CONSOLIDATED
MACHINE TOOL CORPORATION

ROCHESTER 10, NEW YORK

L & S LATHES IN BACK SHOP AND ROUNDHOUSE

BACK shop machine tool supervisors have long been familiar with the superior production and precision features built into L & S Lathes. Installations will be found in wheel departments, tool rooms and in other parts of the locomotive shops where quantity and quality production are chief requirements.

Large engine terminals handling classified repairs are also turning to L & S Lathes because the simplified controls and rapid chucking facilities, including the Key Tapered Spindle Nose, provide the versatile features required of a roundhouse lathe handling a large variety of jobs.

ENGINE
AUTOMATIC
TOOL ROOM
OIL COUNTRY
LATHES

THE LODGE & SHIPLEY MACHINE TOOL CO.

CINCINNATI, 25, OHIO, U. S. A.

L & S LATHES

Even Steel Must Wear Armor...

Against biting, cinder-laden wind . . . slow, seeping moisture . . . even steel must wear Armor.

Every Railway Engineer knows what it is to face especially difficult maintenance problems involving steel structures.

Corrosive gases from locomotive blast . . . cinder abrasion . . . seeping water forming acid solutions . . . these are only a few of the conditions that make effective protection so highly important.

For more than 40 years, The Flintkote Company has pioneered in the development of Industrial Asphalt products for metal protection . . . armor against corrosion. Special emphasis has been placed on railway requirements.

Complete metal protection with Flintkote Protective Coatings offers triple economy. Material cost is comparatively low. Application is fast and simple. Long years of effective protection cut recurrent maintenance costs.

FLINTKOTE
INDUSTRIAL PRODUCTS

The Flintkote Company . . . Industrial Products Division . . . 30 Rockefeller Plaza, New York 20, N. Y.

ATLANTA • BOSTON • CHICAGO HEIGHTS • DETROIT • LOS ANGELES • NEW ORLEANS • WACO • WASHINGTON • TORONTO • MONTREAL

Operator fatigue hurts war production—*eliminate it!*

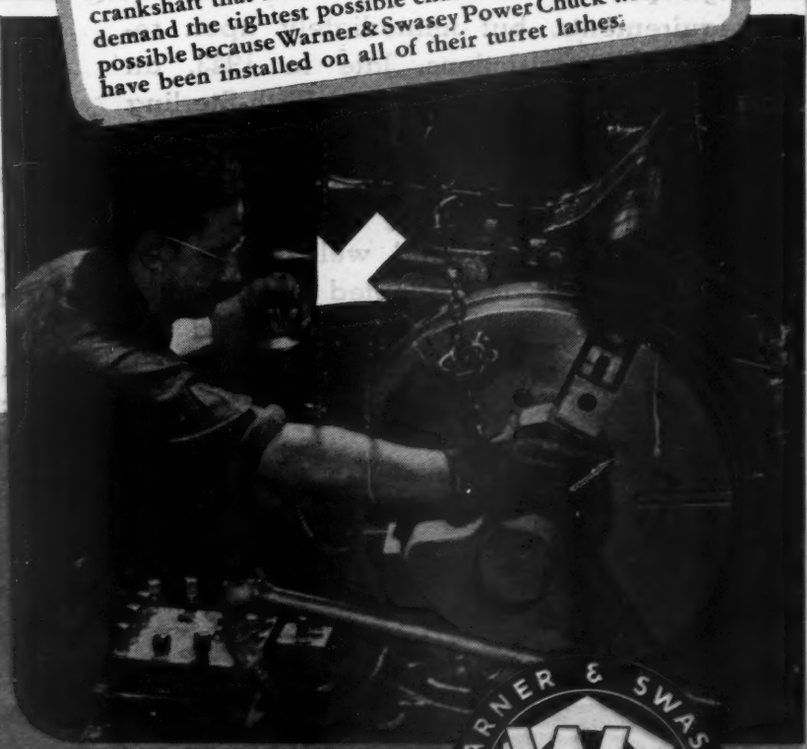
HAND chucking is hard manual labor and chucking takes time, wears down the operator and decreases efficiency.

Warner & Swasey Power Chuck Wrenches have licked the problem of operator fatigue and, consequent production sag. With a Warner & Swasey Power Chuck Wrench the operator can grip the heaviest job with no more effort than it takes to turn a door-knob. Heavy work can be held much tighter than with a hand wrench—light, thin-wall jobs can be held with a uniform light pressure to eliminate distortion.

Warner & Swasey Power Chuck Wrenches Can Be Installed on Your *Current Model* Turret Lathes

If you are taking heavy cuts and chucking pieces by manual strength, multiplied by a pipe extension on the chuck wrench, better find out quickly what a Warner & Swasey Power Chuck Wrench can do for you—in faster production, less scrap loss, and better satisfied operators. See your Warner & Swasey field representative or write Warner & Swasey, Cleveland, Ohio.

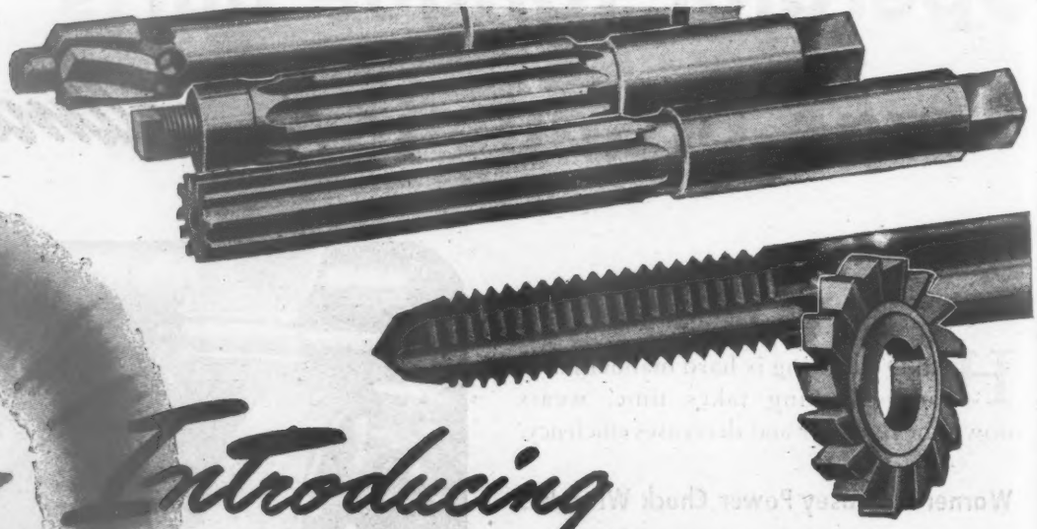
They take off a lot of metal—fast—in the Turret Lathe Department of The Steel Improvement & Forge Company of Cleveland. In one operation five heavy cuts are made simultaneously. In another (see photo above) a heavy interrupted facing cut is made on a tough alloy steel crankshaft that Brinells up to 321 hardness. These cuts demand the tightest possible chucking grip and are only possible because Warner & Swasey Power Chuck Wrenches have been installed on all of their turret lathes.



YOU CAN MACHINE IT BETTER, FASTER, FOR LESS . . . WITH A WARNER & SWASEY

WARNER & SWASEY · CLEVELAND OHIO

TURRET LATHES, SADDLE AND RAM TYPES • CHUCKING AND BAR TOOLS • PRECISION TAPPING AND THREADING MACHINES



MO

Introducing

STAR-MO M-2

TUNGSTEN-MOLYBDENUM HIGH-SPEED STEEL

(M-2 ANALYSIS)

During the period of WPB control, Star-Mo high-speed steel conformed to Government requirements, but immediately upon removal of restrictions, late in 1943, an analysis was adopted by Firth-Sterling which was known as "M-2." Since then, all Star-Mo made has been of this new composition approved by leading automotive manufacturers and well-known tool makers. They also adopted the designation "M-2" to describe this type and we included it in the name for this new product —Star-Mo M-2.

STAR-MO M-2 is *Better.* On many applications it outcuts and outlasts 18-4-1 high-speed steel—a trial will prove it.

STAR-MO M-2 is *Cheaper.* The base price is 14% less than 18-4-1 steels, and in addition Star-Mo M-2 weighs approximately 7% less per foot. May we quote comparative prices?

STAR-MO M-2—is *Easy to Handle.* A Firth-Sterling representative will gladly tell you of its value on applications in your plant, methods of heat treatment, and practical use.

ARMY E NAVY

Firth Sterling

STEEL COMPANY

OFFICES: McKEESPORT, PA. · NEW YORK · HARTFORD · LOS ANGELES · CLEVELAND · CHICAGO · PHILADELPHIA · PITTSBURGH · DAYTON · DETROIT

THE MOTORPUMP IS MANY PUMPS

..one of them will fit your job

Motorpumps are highly efficient, compact and sturdy pumps. There are sizes small enough to be held in the hand and others to handle as much as 1800 gal per minute. The basic unit has a built-in electric motor. However, various modifications such as built-in steam turbine, cradle mounting for any type of drive, sling-yoke mounting for mine or contracting work and many other mountings and special parts provide pumps tailored to your specific needs. Ingersoll-Rand Company, Cameron Pump Division, 11 Broadway, New York 4, N. Y.

Ingersoll-Rand

9-401

NEW QUICK-ACTING HYDRAULIC PRESS

Performs Variety of Forcing Jobs

Watson-Stillman Hydraulic Bushing Presses are made in standard capacities of 50, 100, 150, and 200 tons. Special presses can be built to specifications, embracing all the features of the regular line. Press bed is furnished plain, or with "U" slot as required.

INSERTING and removing connecting rod bushings and driving box brasses . . . bending or straightening rods, levers and other types of connections . . . these are only a few of the numerous jobs that can be done with speed and precision on the new Watson-Stillman Hydraulic Bushing Press. Railroad repair shops, and builders of railroad equipment, will find this press the most efficient machine available for a wide variety of forcing operations required in constructing and repairing locomotives and cars.

It is a self-contained, quick-acting press powered by combination high and low pressure rotary oil pumps. Smooth, shockless ram movement is assured by the special hydraulic power unit and circuit design.

To facilitate introducing work into the press, the pumping unit, valve control and piping are located on top of the press. Pull-back weights are unnecessary because of the double-acting cylinder.

Maintenance is reduced because of the simplicity of design of these presses. There are no poppet valves to seat. No pump plunger, or valve stuffing box packings to require attention. The Watson-Stillman Co., Roselle, New Jersey.

WATSON-STILLMAN

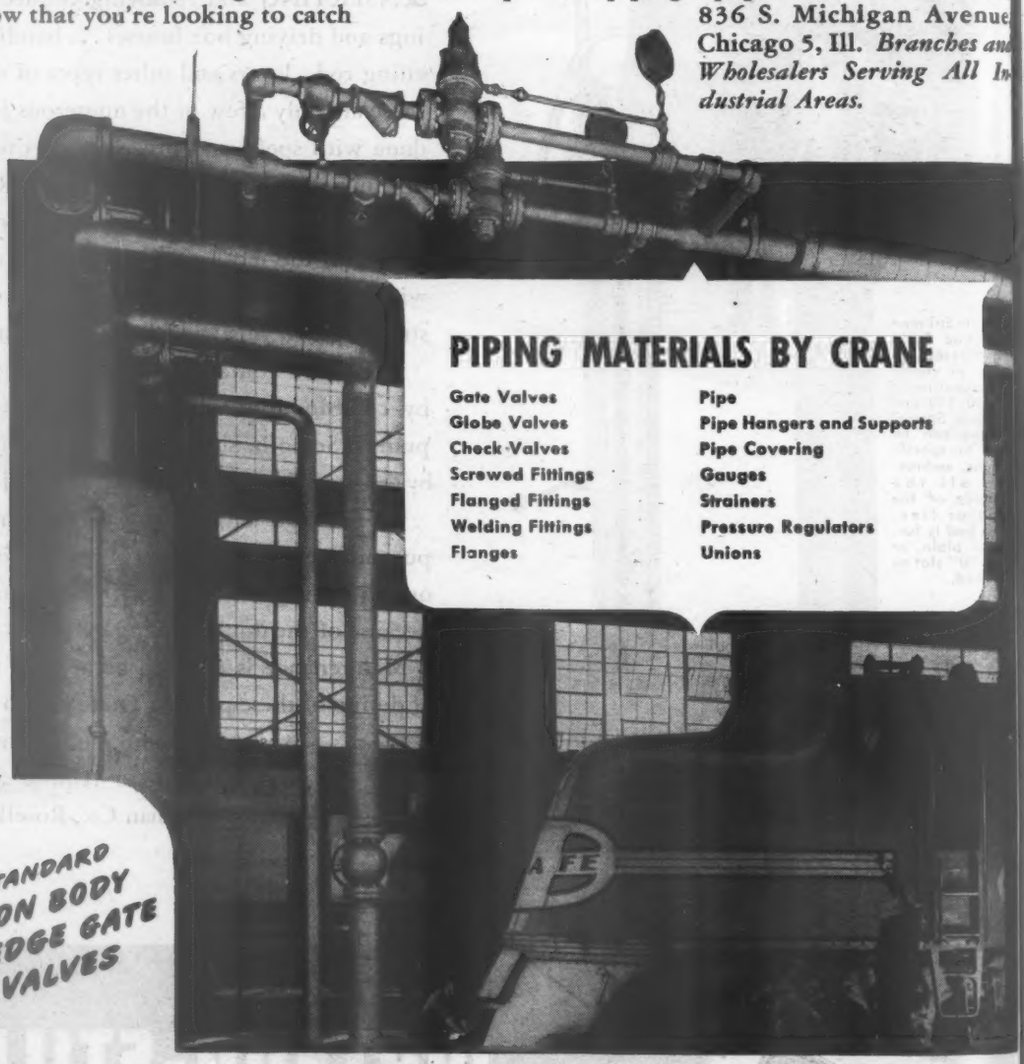
Designers and manufacturers of Hydraulic Equipment, Forged Steel Fittings and Valves

For any railroad service... Crane supplies all piping needs

ONE SOURCE OF SUPPLY... ONE RESPONSIBILITY FOR ALL MATERIALS

When you need piping materials—whether for use on rolling stock, in power plants, shops, stations, or any other application—for the world's largest selection of quality equipment, call Crane! Valves, fittings, including AAR lines, pipe, fabricated assemblies and piping accessories—for high or low pressures—in brass, iron, or steel—Crane supplies them all from one single source.

Keep this in mind, now that you're looking to catch up with war-deferred piping maintenance. All steps of the job, ordering of parts, storing, etc., can be greatly simplified by using Crane *complete* materials service. One responsibility for the quality of all parts gives you stronger assurance of good installations. More, you get full benefit of Crane Co.'s 89-year experience and leadership in the piping equipment field. Crane Co., 836 S. Michigan Avenue, Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas.*



Steam Service Lines in Santa Fe R. R.'s Diesel Locomotive Maintenance Shop.

PIPING MATERIALS BY CRANE

Gate Valves	Pipe
Globe Valves	Pipe Hangers and Supports
Check Valves	Pipe Covering
Screwed Fittings	Gauges
Flanged Fittings	Strainers
Welding Fittings	Pressure Regulators
Flanges	Unions

★ ★ ★ ★ ★ ★ ★

STANDARD IRON BODY WEDGE GATE VALVES

★ ★ ★ ★ ★ ★

ONE STANDARD OF QUALITY

Extra dependability throughout piping systems results when the same high quality guards every part. For example, here's what Crane Iron Body Wedge Gate Valves add to piping performance. Strong body sections resist severest line stresses. Straight-through ports permit unrestricted flow. A deeper stuffing box lengthens packing life. Extra long disc guides keep disc travel true, while fine design and construction in every part of these valves assure long, trouble-free service.

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Does one of these McKAY ELECTRODES

OR DO YOU NEED THIS SPECIAL ONE?

McKAY GIVES YOU THE RESEARCHED LINE

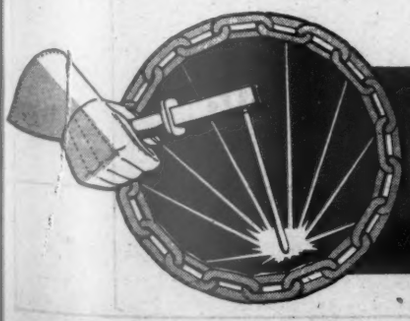
The McKay slogan, *"every* electrode a leader," is based on the determination to make every grade as good as painstaking research, careful manufacturing and unusually thorough step-by-step testing can make it. In addition to our own laboratories, an active fellowship in Mellon Institute fully qualifies McKay Electrodes to be called the *Researched Line.*

You will find in the *standard* line of McKAY Electrodes an exceptionally wide range of mild steel, alloy steel and stainless steel rods of analyses suited to almost every welding need. From a range of 40-odd mild, alloy and stainless grades, you can normally select an electrode which will exactly fit your requirements.

Occasionally, however, the need for a special electrode for a specific purpose will arise. In such cases, the facilities of our plant laboratory, working in collaboration with our Mellon Institute research department, will be placed at your service to develop the proper type of electrode for your particular job.

If available standard selections are not adequate, don't hesitate to ask for *this special* McKay service. Send full technical facts for our recommendations.

GENERAL SALES OFFICES: YORK, PA.

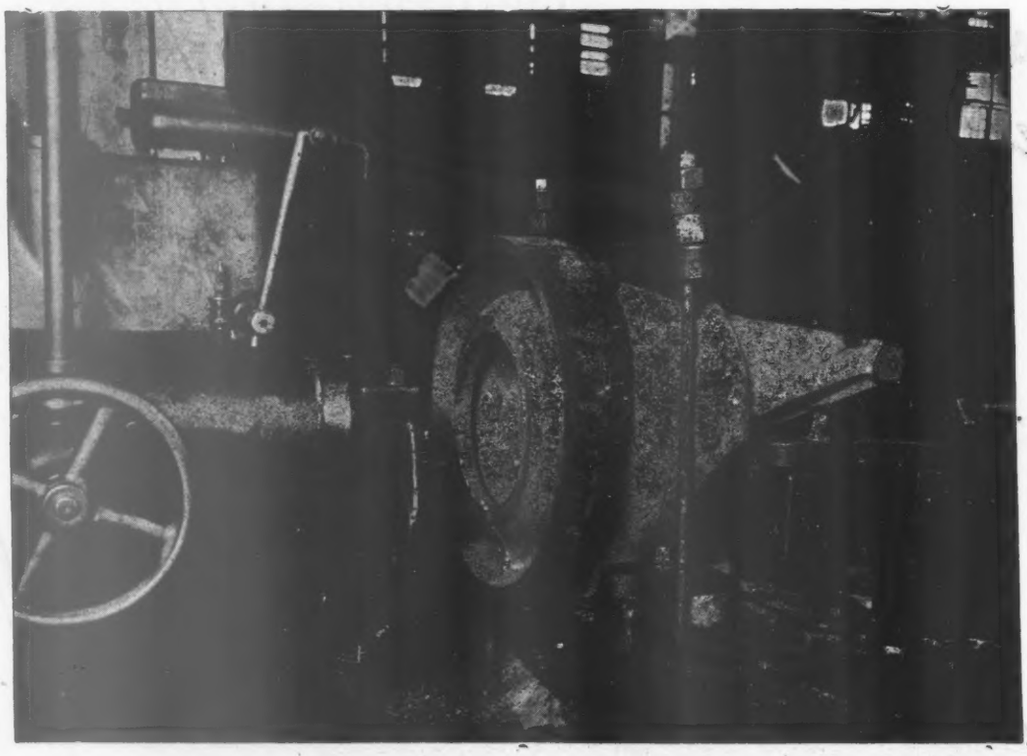


THE McKAY COMPANY

PITTSBURGH, PA.

WELDING ELECTRODES . . . COMMERCIAL CHAINS . . . TIRE CHAINS

LUCAS "PRECISION" JOBS



Note: The many actual photographs of locomotive jobs on the Lucas, used in our advertisements, are definite proof that this time-tried machine is used extensively in railroad shops.

Throttle Boxes

A LUCAS HORIZONTAL Boring Machine job.

A difficult setup to chuck true on a machine requiring the work to revolve,—

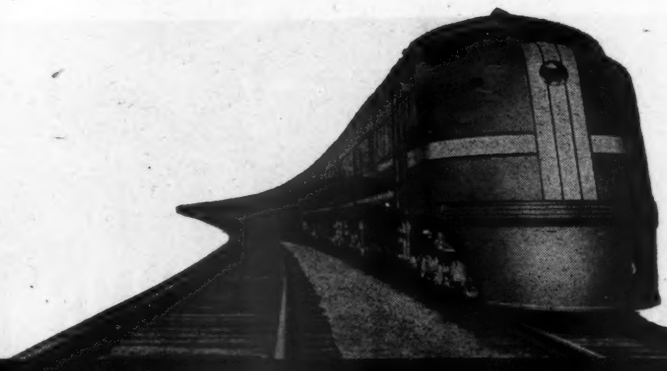
A simple job to lay down at any convenient place on the broad, horizontal surface of the platen on the "Precision" Horizontal Boring, Drilling and Milling Machine and then adjust the platen across and the counterbalanced spindle head vertically by means of the precision traverse screws, in order to center the work with the spindle accurately, quickly and easily.

Furthermore, the job is in the most convenient position for the operator to see the surface being machined.

The Lucas Machine Tool Co.

Cleveland Ohio


PINS
BUSHINGS
WEAR PLATES
Rol-Man Means Rolled Manganese
Wear Parts You Can Install and Forget
Rol-Man Pins, Bushings and Wear Plates are tough-hard, not brittle-hard. Under heavy loads, impacts and abrasion, their surface "work hardens" and strengthens (stiffens) to resist breakage and wear, but the body metal remains in its original tough state. As the hard surface slowly wears, a new one constantly forms, thus the armor never diminishes in thickness. Due to these characteristics, parts of Rol-Man can sometimes be of thinner cross section, to reduce dead weight, without sacrificing safety and long service life. . . . High manganese has a reputation as "the toughest steel." Rol-Man is high (11% to 14%) manganese steel, rolled, forged and processed to multiply the toughness and abrasive resistance of the toughest steel. . . . Rol-Man Pins and Bushings are ground to precision diameters; Wear Plates fabricated to your specifications, ready for installation. . . . Use Rol-Man for replacements and specify it for new equipment. You'll save time and money. Literature on request. Manganese Steel Forge Co.
ROL-MAN



STRESS RESISTANCE MEANS MORE *SAFER* MILES

ARMCO Stress Resistant Wheels stand up under rougher going than other wheels because they resist the specific conditions that cause breakage and serious failure.

Take mileage for example. ARMCO's exclusive "balanced analysis" gives you a wheel with the highest resistance to wear and shelling for a given resistance to thermal cracking. Its thermal cracking resistance is equalled only by wheels with a lower carbon content. Frequent and wasteful shopping is reduced.

These S-R Wheels stay on the job longer because they have lower internal stresses when they start rolling; strong resistance to stresses built up in service; and freedom from defects. They meet the high safety standards you need for your war-time traffic without sacrificing an inch of mileage performance.

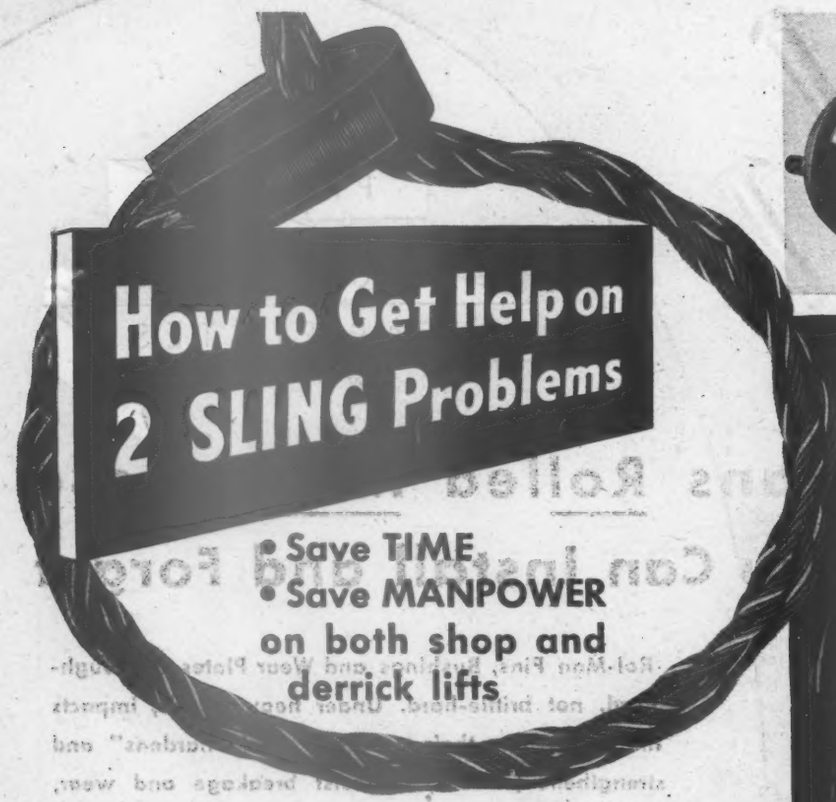
Get all the facts on ARMCO Stress Resistant Wheels from our nearest office, or write direct to Armco Railroad Sales Co., Incorporated, 1711 Curtis Street, Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

ARMCO

ARMCO STRESS RESISTANT WHEELS

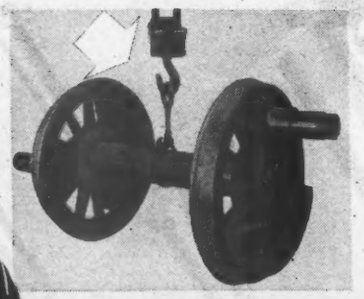
..... State.....

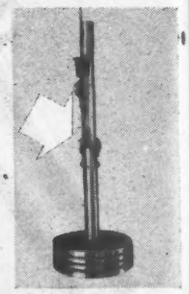


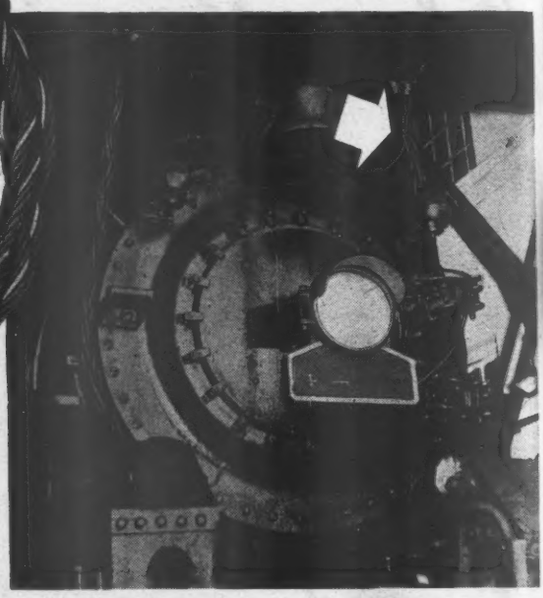
How to Get Help on 2 SLING Problems

- Save TIME
- Save MANPOWER

on both shop and derrick lifts







Picking up a piston rod in the shop and righting a heavy locomotive with a wrecking derrick are two extremes in lifts. Yet both jobs—and scores of others—can be speeded with Yellow Strand Braided Safety Slings.* For these adaptable wire rope slings, properly fitted for the kind of hitch desired, are easily handled, quickly attached and detached. Their patented braiding increases flexibility . . . cuts down the tendency to kink . . . promotes security for men and loads.

Since Yellow Strand Braided Slings weigh much less than the traditional type, fewer men are needed to work with them. Annealing and normalizing operations are also saved. Leading railroads are using braided slings to lift steam, Diesel and electric locomotives, super-heaters, truck assemblies, wheels, rims, journal boxes and rods; to move obstructions, to handle derailed cars by the drawbar, to pull in and hoist damaged units. Durable Yellow Strand Braided Slings will help you return equipment to service faster. Write now for information.

Broderick & Bascom Rope Co., Saint Louis

Branches: New York, Chicago, Houston, Portland, Seattle
Factories: St. Louis, Seattle, Peoria

Riggers' Hand Book—Shows sling types, fittings, capacities. Send for FREE copy.

*Patents:
U. S., 1475859, 1524671, 2142641, 2142642, 2299568;
Canadian, 252874, 258068

ARMY E NAVY

BRODERICK & BASCOM

YELLOW STRAND

Braided Wire Rope SAFETY SLINGS

STRESS RESISTANCE MEANS MORE *SAFER* MILES

ARMCO Stress Resistant Wheels stand up under rougher going than other wheels because they resist the specific conditions that cause breakage and serious failure.

Take mileage for example. ARMCO's exclusive "balanced analysis" gives you a wheel with the highest resistance to wear and shelling for a given resistance to thermal cracking. Its thermal cracking resistance is equalled only by wheels with a lower carbon content. Frequent and wasteful shopping is reduced.

These S-R Wheels stay on the job longer because they have lower internal stresses when they start rolling; strong resistance to stresses built up in service; and freedom from defects. They meet the high safety standards you need for your war-time traffic without sacrificing an inch of mileage performance.

Get all the facts on ARMCO Stress Resistant Wheels from our nearest office, or write direct to Armco Railroad Sales Co., Incorporated, 1711 Curtis Street, Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

ARMCO

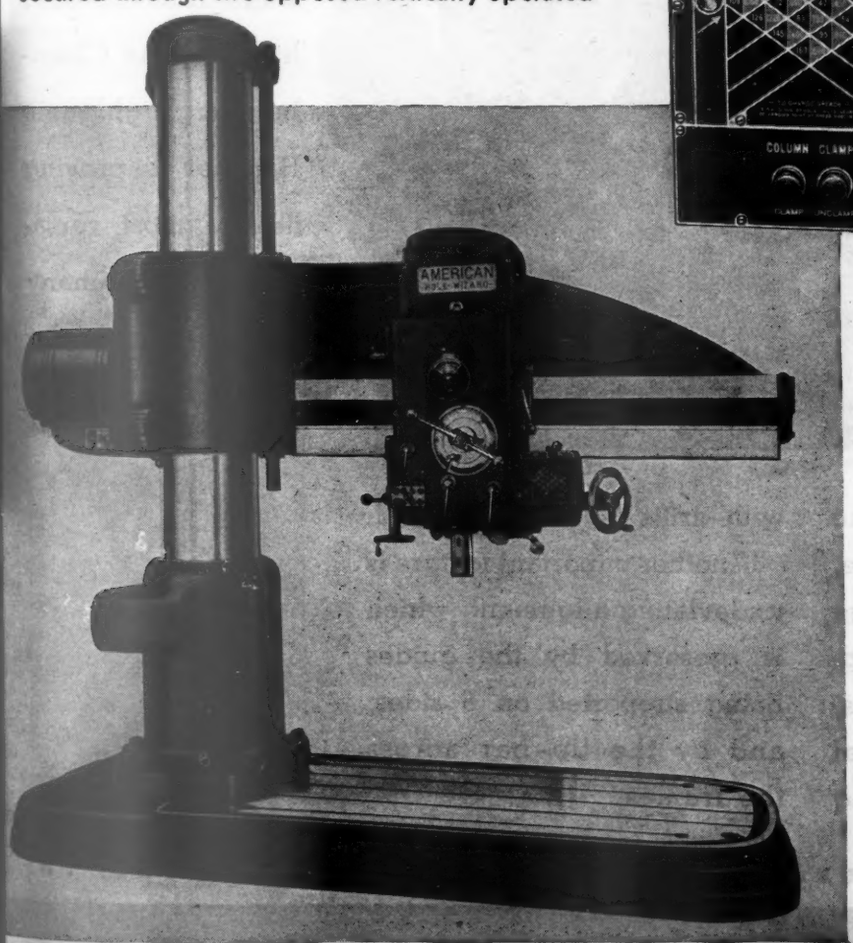
ARMCO STRESS RESISTANT WHEELS

32 SPINDLE SPEEDS

...with only 2 Control Levers and 1 Back Gear Lever

Operators are enthusiastic in their praise of this new direct reading speed control. They don't have to refer to index plates or retain lever positions in their minds when making speed changes. Its superiority and convenience encourages operators to use correct speeds for their work. Being direct reading, operators are not fearful of making mistakes.

The entire range of 32 spindle speeds is secured through two opposed vertically operated



levers which are direct reading and one two-position back gear lever used only when changing from the high to the low speed range or vice versa.

This new speed control makes work easier; increases production because of it and the payroll dollar buys more as a consequence.

This and other fine features of the "American" Hole Wizard Radial Drill are thoroughly illustrated and described by Bulletin No. 326.

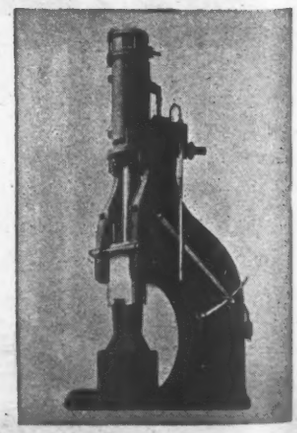
THE AMERICAN TOOL WORKS CO.

Cincinnati, Ohio, U. S. A.

Lathes and Radial Drills

Versatile Frame Hammer

Designed especially for a wider range of work than the usual single frame forging hammer, the ChambersburgHighFrame Hammer is proving itself a most versatile tool in many shops.



BECAUSE of its high frame and greater working space, it is now possible to forge large discs and rings, to upset high stems, form arch bars, etc. on the most economical size of tool. Long punching with drifts is also facilitated.

Another important feature is undeviating alignment, which is preserved by the guides being supported on 5 sides, and by the tie-bar across the frames.

CHAMBERSBURG ENGINEERING CO., CHAMBERSBURG, PA.

ARMY E NAVY

CHAMBERSBURG

HAMMERS · CECOSTAMPS · PRESSES

7 REASONS* WHY

our best bet for AC Welding is a "Bumblebee"

with a Stinger that Penetrates

Every feature of design and construction, both inside and outside the sturdy case of the Wilson "Bumblebee", has been planned to give the utmost in efficient, dependable and economical service:

1. *Precise, Stepless Adjustment of Welding Current* to any value within NEMA range, provided by easy-turning crank.
2. *Efficient Ventilation* by motor-driven fan assures safe, dependable operation, even when welding with maximum current.
3. *Reduced Power Factor Charges* and relief for overloaded power lines is provided by built-in capacitors.
4. *Coils Protected Against Fire and Vermin* by mica and glass fabric insulation.
5. *Interchangeable Primary Terminals* permit easy, rapid change from low to high line voltage or vice versa.
6. *Output or Secondary Terminals Readily Accessible* by removing 4 screws which hold small insulating panel.
7. *High Visibility of Current Indicator* is assured by large, easily read calibrated scale located outside case.

These features are incorporated in every "Bumblebee" welder—either regular or all-weather model. "Bumblebee" welders are also performing a valuable service as a power source for automatic welding heads.

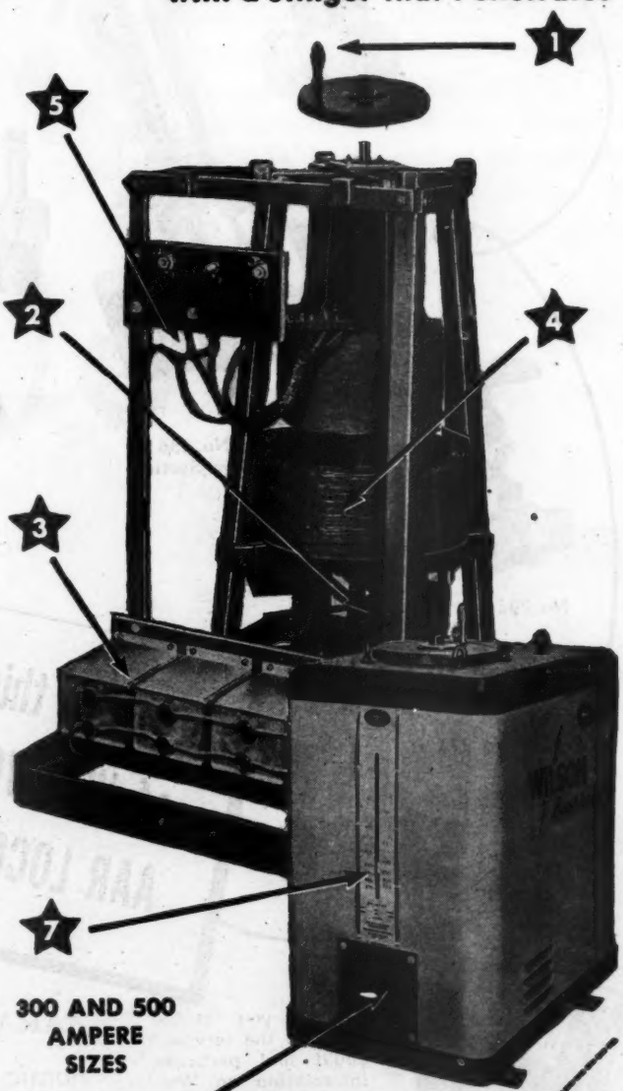
In addition, the "Bumblebee" offers all the advantages of AC welding:

- —Low Maintenance because of absence of moving parts
- —Low Power Costs because of high electrical efficiency
- —Faster Welding due to absence of arc blow and use of larger electrodes
- —Improved Quality of Welds

—at no greater first cost than other types of welding equipment.

Other AC welders in 100, 200, 750, 1000 ampere sizes.

Mail the coupon today for new catalog—or write to your nearest Airco office.



300 AND 500 AMPERE SIZES

RME

Air Reduction
60 E. 42nd Street
New York 17, N.Y.

Please send copy of your new "Bumblebee" Catalog to

Name.....

Firm.....

Address.....

City..... State.....

BUY UNITED STATES WAR BONDS

AIR REDUCTION

General Offices: 60 East 42nd Street, New York 17, N. Y.
In Texas: Magnolia Airco Gas Products Co. General Offices: Houston 1, Tex.
Offices in all Principal Cities

FIT THE VALVE TO THE SERVICE

...from this complete line of WALWORTH BRONZE AAR LOCOMOTIVE VALVES

To help you "fit the valve to the service," you'll find pertinent information on Walworth's complete line of valves, fittings, pipe, and pipe wrenches in the new Walworth Catalog 42. Included are 78 pages of practical engineering data that simplify valve selection and make piping layouts easier. Write, on business stationery, for your free copy. Address: Walworth Company, 60 East 42nd Street, New York 17, N. Y., Department D-20

AAR Valves have fully proven their worth in the economic operation of locomotives. Walworth produces a *complete line* of these AAR Valves, illustrated above. In addition to AAR Valves, Walworth also produces a *complete line* of AAR Unions, Union Fittings, and Fittings as well as valves and fittings of steel, bronze, or iron for all railroad piping requirements.

BOSTON WORKS
KEWANEE WORKS

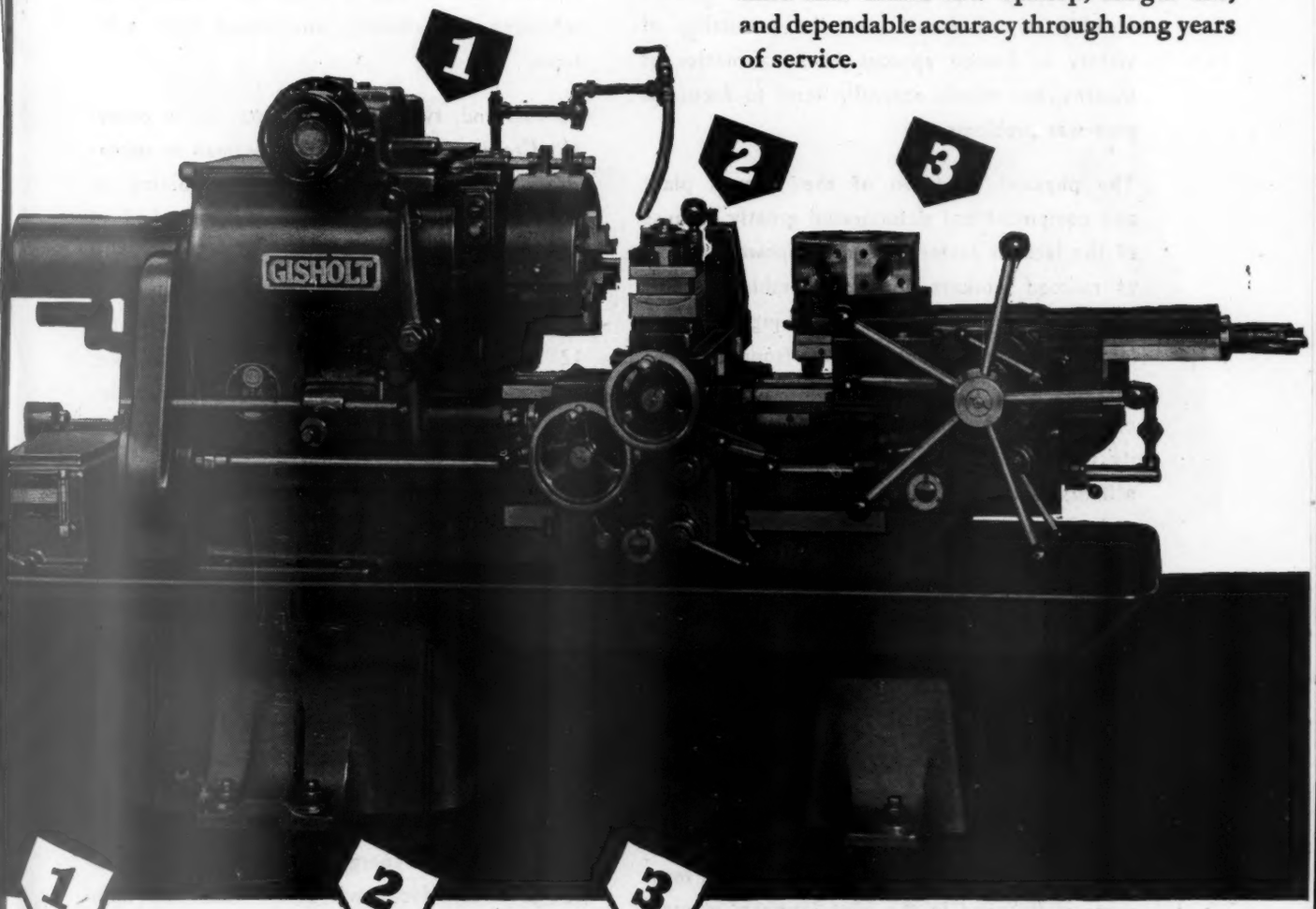
WALWORTH
valves AND fittings

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

Strength . . .

WHERE IT'S NEEDED MOST!

STRENGTH—*tremendous strength*—enables these Gisholt Ram Type Turret Lathes to take all the punishment you'll ever give them. No detail has been overlooked to assure the sturdiness for extra capacity—for heavy, multiple cuts up to the limit of tools without danger of breakage. This is strength of the enduring kind that means low upkeep, longer life, and dependable accuracy through long years of service.



1 Rigid, one-piece bed and headstock are cast integrally and stiffened with cross ribs, permitting the heaviest cutting loads without vibration. Heat-treated alloy gears are carried on taper and ball bearings throughout. Power is transmitted through a sturdy multiple disc clutch.

2 Bed ways, turret ways, gibs and clamps are hardened steel. Binder lever locks square turret in place, in effect as one piece with cross slide. Extended carriage wings prevent tilting. Broad cross slide provides rigid support for cutting tools.

3 Double beveled clamp ring binds turret rigidly to slide, relieves locating pin and bushings of all strain in taking heavy cuts. There is no chance for the turret to weave and lose accuracy. Protected gib lock keeps turret slide in exact alignment. Turret head is extra heavy with large protected bearing directly on ram.

GISHOLT MACHINE COMPANY • *1293 E. Washington Ave., Madison 3, Wis.*

Look Ahead...Keep Ahead...With Gisholt Improvements in Metal Turning

GISHOLT

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

THE EDITOR'S DESK

Looking Ahead

As we approach the year's end; as our armed forces and those of our Allies move forward steadily on all fronts and the possibility of victory in Europe appears to be a matter of months, our minds naturally tend to focus on post-war problems.

The physical condition of the railroad plant and equipment has deteriorated greatly because of the lack of materials and manpower. A host of railroad workers and considerable numbers of officers and supervisors are giving an excellent account of themselves at the front, although they are sadly needed here at home, where the continuous back-breaking demands of a capacity freight and passenger business have forced officers and men to the very limit of their endurance.

With victory in Europe we will, of course, still face heavy traffic conditions as war operations concentrate in the Orient. Let us hope, however, that ample materials and manpower will be available for the rehabilitation of railroad facilities and equipment.

The railroads must frankly face the fact that they will be confronted with serious competition from other types of carriers. To meet this most successfully—and in the joint interests of men, management, owners and the public—it will be necessary to bring about the closest possible type of co-operation between the workers and management. All concerned have suffered too greatly in the past because of ignorance of simple principles of economics and the lack of tact and understanding as to how to deal with each other. What is needed is a lot of sound common sense and a reasonable amount of schooling in economics and sound labor relations.

To this end, two suggestions may be in order: (1) Continue and extend the foreman or supervisory training methods and the training of workers, similar to those measures applied so successfully during the emergency. With more time available they can be refined and improved to achieve still higher standards of efficiency. (2) Deliberately adopt measures for educating both men and management in those principles and practices which make for better and more co-operative understandings.

In this latter connection the experiment now being conducted on the Boston & Maine, in which a lecture and discussion course is being promoted jointly by labor and management, under the auspices of the Railroad Y. M. C. A. and the Massachusetts Division of University Extension, seems to have great possibilities. Certainly the stakes for both the men and the management in maintaining prosperity of the railroads are so great that the expenditure of much time and energy will be justified in a co-operative educational effort that will help to eliminate needless and costly friction and misunderstandings.

Roy V. Wright

The KING WAY

REDUCES TIRE TURNING COSTS

Illustrations show two Heavy Duty King Boring Mills machining tires. Above, an 84" Mill installed in a Western Railroad shop boring a 56" tire — left, a 100" Mill installed in a large Eastern Railroad shop boring a 56" tire.

KING Heavy Duty Boring and Turning Mills are noted for their rugged construction, accuracy and abundance of power to take heavy cuts far beyond capacity of high-speed cutting tools. The jobs of boring tires and turning wheel centers are just about the toughest that are chucked on a boring mill—therefore, the fact that the majority of railroad shop supervisors prefer King Mills for these jobs is highly significant. You can obtain King Heavy Duty Double Column Mills from 52" to 144" swing—either with or without side heads.

The KING MACHINE TOOL Company

BUILDERS OF VERTICAL BORING AND TURNING MACHINES EXCLUSIVELY

CINCINNATI, OHIO

How to unmask this seasonal Water Goblin

Autumn is the season of lowest water level in streams, rivers, and other sources of feedwater supply. Fall rains add to the high organic concentrations.

Feedwater then turns into a water goblin swollen with steam bubbles which rise to dangerous levels and foam in the boiler.

To unmask the foaming offender, Dearborn Laboratories developed Anti-Foam, a compound which maintains high, *safe* concentrations of foam-neutralizing salts in the boiler.

Anti-Foam contains *no* castor oil. It is non-saponifiable and non-hydrolyzable in alkaline boiler waters; does not form residual soap to create a foaming boiler in sections where water does not require treatment. During layover periods or in operations over several divisions, it is unnecessary to change water in the boiler or tender tank when Anti-Foam is used. It has an effective life many times that of any of the known available organic Anti-Foam materials.

In powder, paste, liquid, and brick form for manual or wayside application. Let Dearborn engineers tell *you* about Anti-Foam—today.

DEARBORN CHEMICAL COMPANY

310 S. Michigan Ave., Chicago 4
205 E. 42nd St., New York
807-15 Mateo St., Los Angeles
2454 Dundas St., West, Toronto

Dearborn
TRADE MARK REGISTERED

ANTI-FOAM
STABILIZER FINISHING TREATMENT

WE SAY IT AGAIN

TAKE FRONT RANK IN RAILROAD APPLICATIONS

WE emphasize the universal employment of Anderson Plugs and Receptacles because of its significance. Since the days when electricity was first put to use in railroad shops, for lighting and for subsequent applications, our products have kept step with the industry.

Anderson equipment is manufactured to the most rigid specifications for use in connection with Air Conditioning, Battery Charging, Marker Lights, Yard Receptacles, Platform Receptacles, Portable Tools, Telephones, Switchboards, Welding Couplers, Watertight Plugs and Receptacles, Turntables, Industrial Trucks.

ARMY E NAVY

ANDERSON M.F.G. CO.

289-305 A Street, Boston 10, Mass.

NEW YORK CHICAGO PHILADELPHIA LONDON

just a Stumble bum

You've seen them in the ring floundering around under a rain of gloved fists. You've seen them cadging nickels and dimes on the streets . . . the men who paid no heed to the ravages of time and remained in a profession whose great requisite is youth. The years caught up with them. And with the years came the cauliflower ears, the scar tissue around the eyes, the crooked nose. Once they were good. Now they are "Has Beens"—"Stumble Bums" unfit for the gruelling competition of their calling.

But what about those "Stumble Bums" in your plant, Mr. Manufacturer? Those old lathes of yours that have seen better days. Once they were good too, probably the best. But the years have caught up with them and now they too are just "Stumble Bums"—and very definitely unfit for real competitive production.

Investigate the merits of the New LeBlond Lathes. They'll help you meet tomorrow's greater, keener competition with confidence.

LeBlond is building tomorrow's lathes today. Write for catalog

LEBLOND No. 6 GUN BORING LATHE

AT YOUR SERVICE

We have been building lathes since 1887. Today LeBlond Lathes are used on turning operations the world over. The accumulated knowledge of every manufacturing trend in good times and bad . . . peace and war, gained from thousands of installations is now available to you.

Our field engineers are at your service . . . ready to help you in your development work for the postwar era—particularly along the lines of the difficult, out-of-the ordinary turning problems. This service is yours for the asking. Contact our nearest dealer or write—Department FE-46.

★ YOUR BONDS BUY BOMBS ★ BUY A "BLOCK-BUSTER" TODAY

THE R. K. Le BLOND MACHINE TOOL CO., CINCINNATI 8, OHIO, U. S. A.

NEW YORK 13, 103 Lafayette St., CAnal 6-5281

CHICAGO 6, 20 N. Wacker Dr., STA 5561

LARGEST MANUFACTURER OF A COMPLETE LINE OF LATHES